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ACROSS THE LIBYAN DESERT TO KUFARA

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(*Continued from p.* 101. *Map following p.* 248.)

FROM Buseima there are two routes to Kufara. The direct one takes three and a half days, and is 145 kms. to Hawari, an oasis lying 16 to 20 kms. north of the wadi containing the villages of Kufara. The other takes four days, is by way of Ribiana (which lies due south of Buseima, two days' journey through the worst dunes in the neighbourhood), and ends at Tolab, the most westerly village in the Kufara wadi. From the highest block of the Buseima Garah one can see the mountain of Ribiana, and from high points in the dunes on the direct way to Kufara one also has a view of this tabular chain.

We left Buseima early on January 8, having induced the principal inhabitants to sign a wonderful document stating that under the orders of Sidi Idris, the Sayeda Khadija and Ahmed Mohammed Bey Hassanein had visited the oasis on such and such a date. I remember the "fatha" was solemnly repeated on the edge of the dunes, and immediately afterwards the most vindictive Zouiya muttered, "You should not escape thus; we had men enough to kill you!" For two days we travelled through rolling dunes, with occasional definite ridges rising into peaks, on one of which the aneroid registered 460 metres. No general direction could be observed among the dunes. Each afternoon a naga foaled, so we had to camp early.

On the morning of January 9 we mounted a noticeably high dune, called the "Seif el Biram," and had our first view of the Hawaish mountains on the Zieghen route to the east. On January 10, after the aneroid had shown 520 metres, the dunes began to get smaller. In the morning when we mounted the last ridge we had a marvellous view of a land enclosed apparently on every side by mountains. Behind us the Buseima Garah had disappeared, but from Ribiana on the west the long chain of the Gebel Neri ran in a complete semicircle by way of the Hawari Garah to join the Hawaish mountains on the east, while to the north the Gebel Fadil continued the line. The latter are called after the family who missed the Zieghen well and died of thirst in the mountains. The Hawaish mountains were originally called "Keid el Adu" (vexation of

the enemy). "Hawaish" simply means "great beast," and refers to supposed mysterious inhabitants of the region, alternatively djinns or snakes! We passed through three ranges of Hawaish on our homeward route and saw nothing living, but tracks of large snakes have been seen by natives.

The third day the sand gradually changed in colour, becoming amber and pinkish, while on the fourth (January 11), as we drew near the Gebel Neri, we came to a stony waste, with banks and mounds of sandstone. The sand was really red, in places an extraordinary vermilion, and there was much black Nubian sandstone with strange black concretions in the form of hollow symmetrical black tubes and balls, the largest ball a foot in diameter and the smallest half an inch. These were strewn broadcast after we passed the Hawari Garah, a group of tabular hills, on our left. Three hours later we arrived at Hawari, a long strip of palms with a few isolated groves at either end, lying in a slight depression and surrounded by a band of pale vermilion mounds of "hattab" gherds covered with a low growth of tamarisk, thorns, and prickly grey bushes whose name I do not know.

All the way from Buseima we had marched on a bearing of 130°. With the exception of one day, when there was a north-east wind, it had been still and exceedingly hot, with a noon temperature of 45° Cent. The day after we arrived at Hawari it was 44° Cent. inside the tent, which was pitched in an open, shadeless space outside the village, beside the extensive palm gardens belonging to the Sayeds and inhabited only by their Sudanese slaves.

From Hawari nothing of Kufara is visible. Beyond a stretch of fairly level sand, irregular reddish hills and gherds shut in the horizon. The large village of Hawari is scattered over a few square kilometres among palms, thorns, and some acacias. The houses are large and well built of neat, even white mud bricks, better than any houses we had seen in the north. Some of the long porches inside the yards had a row of pillars and arches. The Zawia is small and insignificant, with a small new tomb of a former muezzin. Its sheikh, Musa Squairin, practically took up his abode in our camp to protect us from the virulent hostility of the Zouiyas.

The story of our adventures at Hawari is too long to be told in the space at my disposal, but Abdulla's plot was so nearly successful that it is worth explaining. The crafty Zouiya knew that once the story of his loss of direction on the Taiserbo route were known, his reputation as guide would be ended and he would lose his whole means of livelihood. He decided that the best way to obliterate the memory of his error was that all who knew of it should disappear. Obviously the caravan could not be atacked by his fellow-tribesmen while he was with it. Therefore he went on to Taj to inform the Kaimakaan of our arrival and to prepare a house for us, instructing us to follow him without fail next morning, while he secretly told the Zouiyas, already inflamed against us by the

emissaries of the Bazama family, that we were dangerous Christian spies who had forged letters from the Emir, and that they must stop us leaving Hawari at all costs. He imagined that we should insist on departing, and in the general battle the blacks would be obliged to defend us, and we should all perish.

This might have happened had we not attempted to go to Hawawiri, at the eastern end of the Hawari oasis, the afternoon after Abdulla had left us. With the exception of the two Farraj the blacks refused to accompany us, and after a few hundred yards we were surrounded by an angry crowd of Zouiyas, all armed with modern German rifles. I imagine we owed our lives on that occasion to the eloquence of Hassanein Bey and to the timely intervention on our behalf of some Tebu headmen.

Unfortunately the chief sheikh of the place, Bu Shnaf, was away in Jof, and no one else appeared to have much authority over the tribesmen. We were kept prisoners in our tents for the remainder of that day (January 12), and violent councils were held outside as to whether we should be destroyed or not. Our worst enemies were Bu Badr, Sheikh Zarrug of the Hawaij, and the Fiki of the town, Sheikh Saad, who was generally the spokesman, while the very small party in our favour was headed by Musa Ghrebil.

Early on the morning of January 13 we smuggled Mohammed Quemish out of the camp with the connivance of the Sheikh el Zawia, who lent him a donkey, on which he rode some 18 or 20 kms. to Taj, explained matters satisfactorily to the Kaimakaan, and arrived back at Hawari at sunset with an official invitation to us to proceed.

We had spent a terrible day as prisoners of the Zouiyas, and I began to understand the horrors of Rohlfs' position, for these tribesmen are quite different from the usual Bedawin. They are treacherous and cruel, arrogant and suspicious, with no respect for the laws of hospitality. Fanatically determined that no strangers shall cross their borders, they are also robbers. Most of these characteristics show in their thin, low-browed faces, with drooping lips, dull eyes, pale anæmic skins, and pinched nostrils. They have brown hair, often very light, and sometimes greenish-grey eyes; but I have never seen cunning and distrust so visibly stamped on a mass of faces.

As soon as the orders from Taj were read the mental atmosphere changed, a sheep was killed in our honour, and those who had wished to kill us a few hours ago sat round our camp fire and told us stories of our gallant predecessor's adventures in the oasis.

They remembered all sorts of funny little personal details about Rohlfs, but stated that Bukr Bu Guetin had from the beginning meant to despoil the exceedingly rich caravan. They traced the German's route for us from Hawawiri round the edge of the mountains to the outskirts of Boema, the most easterly oasis in Kufara wadi, where his camp was destroyed, and he was a prisoner till he escaped with Bu Korayim to

Zuruk; but one and all they assured us that "Mustapha Bey" was alone with Ali, his cook, and a "very big horse." Zarrug and Bu Badr were most emphatic that no other European was with him.

On January 14 we went to Hawawiri, where there are only three houses, as most of the palms are owned by people in Jof and Boema. It is barely separated from the long Hawari belt of palms, and about 8 kms. from the village of that name. We then rejoined the caravan marching towards Taj, nearly 20 kms. of rough uneven country across stretches of stones and sand between rocks, mounds, and hillocks, with a few large sandstone gherds. From the top of every small rise we expected to see Kufara, but not until it was barely a mile away did we perceive the small dark-walled town of Taj, the sacred city of the Senussi, containing only the Zawia of the Asyad, with the "Qubba" of the Mahdi and the houses of the Senussi family and principal Ekhwan.

Built of uneven blocks of the prevalent black stone, with red sand-mortar, the long low walls, windowless and solid, giving the impression of small fortresses rather than houses, the whole place is so much the colour of the surrounding country that it is practically invisible. Only when one is a few hundred yards from the town does one see that it stands on the edge of a cliff about 100 feet high. In this sanctuary there is no blade of grass or vegetation of any sort, and the wells are 120 feet deep. It entirely depends for its existence on the valley below, from which slaves bring up wood, charcoal, food, and all other necessities of life. One is not allowed to ride into Taj, nor are there any animals within its clustered houses, between which are the narrowest little winding sandy passages.

The wadi, seen from the cliffs of Taj, is exceedingly beautiful. It is 68 kms. long and 15 to 30 kms. broad in the middle. At its eastern end it narrows to a point; at its south-western it runs out into flat sand. It is almost entirely surrounded by a line of purplish-red hills and gherds averaging 100 feet high, which in some places turn into steep cliffs, with irregular defiles leading down to the valley. There is a break in the hillocks behind Zuruk, and they cease altogether beyond Tolab. The vegetation is by no means continuous. The main mass of palms begins at Jof and sweeps westward to Talakh, enclosing at its eastern end a big salt marsh with a salt lake, dry in summer, and at its western a delightful little lake, intensely blue, called the "Bahr el Azraq." This latter cannot be seen from the cliffs.

Other blocks of palms are at Boema, Buma (where there is also a salt marsh and a large salt lake surrounded by high reeds), Zuruk, Tolab, and Talalib. On the salt marshes there are ruins of Tebu villages similar to those found in Buseima, and on each there is a larger round building, similar in shape and design, which might have been a castle or fort.

There has been no rainfall in Kufara for eight years, and there are no springs, but water is to be found nearly everywhere in the wadi at a depth

THE HAWARI GARAH NORTH OF KUFARA

TAJ ON THE CLIFF ABOVE THE KUFARA DEPRESSION

TEBU VILLAGE AT JOF

THE TOWN OF JOF

of 9 feet, and an excellent system of irrigation has been arranged in the oasis by means of shadufs with artificial channels and small reservoirs. Barley, wheat, millet, roses, verbena, lemons, olives, figs, peaches, and grapes are cultivated, as well as such vegetables as pumpkins, tomatoes, radishes, cucumbers, marrow molokhia, which makes a form of spinach. There is practically no grazing in the wadi, except the reeds by the lake banks. The few camels are date-fed. In seasons when the grazing in Cyrenaica is good, the Kufara Zouiyas take their camels up to Barka in the foaling months. When there is no grass in the north, large caravans come and buy all the Kufara dates, so that one has then to pay a mejidie (*3s. 6d.*) for a pound or two of dates in the wadi. When we were there one could buy a camel's load for a mejidie, and tons were rotting on the ground. Sheep and goats are worth five and four mejidies respectively.

There is no weaving in the wadi. The rich silk and embroidered clothes worn by the Ekhwan, and the Zouiyas' jerds, come from Egypt. Tanned and scarlet-dyed leather from Wadai and Darfur is sold at 14*s.* for a whole goatskin. Heel-less and nail-less boots of yellow and scarlet leather are made in Jof, where there is a bi-weekly market for the sale of girbas, live stock, food-stuffs, and European stores, the latter at exceedingly high rates. Slaves are sold by private treaty. Men fetch about £20, and women up to £34 according to their age.

The Tebus weave baskets and mats, rope and sandals from palm fibre. Rose-water scent and vinegar are made from the roses and grapes. Before the war caravans of anything from 100 to 300 camels would come weekly from the south bringing hides, ivory, feathers, and sandalwood; but now there is practically no trade.

The main town in the wadi is Jof, where is the famous Zawia el Istat, founded by order of Sidi Ben Ali, and rebuilt by the Mahdi. The Sheikh is Mohammed Bu Zena. There is a large mosque and the Qubba of the daughters of the Mahdi, which is much revered. There are no proper streets in Jof. It is an irregular mass of dark-walled, windowless buildings, solid and low, widely scattered over an extent of perhaps 5 sq. kms.

There are minor villages at Boema, Buma, and Tolab, and a few small houses, chiefly of palms, at Talakh and Talalib. Zuruk is inhabited only by the slaves who cultivate the palms. Exclusive of the large quantity of slave labour, I should estimate that the population of the whole group of oases does not exceed 3000 Zouiyas, with 300 or 400 Tebu. These latter people have a village of their own outside Jof, under a headman called Saad el Tabawi.

We saw no animals or birds in the wadi, but were told that in the harvest time (in March) many different varieties appear. Cleopatra's asp exists, together with several other varieties of snakes large and small, some of them poisonous, as well as beetles, spiders, and lizards. We noticed mimosa, figs, tamarisks, acacias and thorns, besides some native bushes whose names are unknown to the Zouiyas.

Except for the negroid slaves working in the gardens of the oasis, I never saw a woman in Kufara. They are most rigidly secluded, and never leave their houses. If obliged to travel, they do so at night. At Hawari and Awardel many came to me to be doctored, but, typical of the distrust and reserve of their tribe, they never showed me their faces.

On the day of our arrival we were received on the outskirts of Taj by the four most prominent officials of the Senussi government: the acting Kaimakaan and Wakil of Sayed el Abed, Sayed Saleh el Baskari; the Judge Sidi Osman; Sidi Abdel Rahman Bu Zettina, the second adviser; and Sidi Mohammed Bu Fadeel, brother of the absent Kaimakaan.

We were lodged in the beautiful house of the Emir Idris under the charge of Sidi Mahmud el Jeddawi, his Wakil, who had received orders from the ever hospitable Sayed Rida to entertain us lavishly. Apart from a magnificent initial dinner, he had no chance of doing so, for the acting Kaimakaan generously insisted on providing us with prodigious meals twice a day in the house of Sidi el Abed, who was then in Cyrenaica. A considerable amount of luxury prevails in the houses of the important Senussi Ekhwan. There were fine carpets, brass and silver work, with the usual masses of clocks, cushions, and European ornaments, and in the larger reception rooms one generally found a row of the immense painted chests in which men carry their luggage on their long camel journeys.

It will thus be seen that, apart from the beauty of the valley, the interest of Kufara to the ordinary traveller lies not in any startling features, natural or architectural, for there is nothing unusual in the group of villages with their salt lakes and palms, but in the fact that in this oasis some 600 kms. from the outskirts of civilization, surrounded by formidable natural barriers, there exists a self-sufficient, self-supporting community, educated and intelligent, utterly remote from, almost oblivious of, the existence of the outer world.

We spent nine days in Sidi Idris' house and, under the protection of the Government, found no difficulty in exploring Jof and Taj. In the latter we penetrated by way of the large simple mosque, with square, white pillars and palm-trunk roof, to the Qubba of the Mahdi, the sacrosanct spot of the Senussi, where the tomb of their saint, covered with a plain red cloth, stands at the end of a long, low chamber, the floor covered with graves of other members of the family, and the walls with texts from the Koran.

It was much more difficult to explore the wadi. When we first suggested visiting the outlying villages, fifteen Zouiya headmen, led by Hamid Bu Korayim, son of the man who saved Rohlfs, Suleiman Bu Matar, Bu Shnaf, and Mabruk Bu Helayig, came to protest. There was an exceedingly stormy meeting, which ended with our being angrily warned that our blood was on our own heads if we went further than Jof.

Unfortunately, among the Zouiyas in Kufara there is no one supreme Sheikh to whom all the others are responsible. The tribe is broken up

into families and groups, each of which owns a separate headman owing allegiance to none. Nevertheless, under the reluctant guidance of Sheikh Mohammed Lefaitah, we made the tour of inspection of the eastern end of the wadi, after which Suleiman Bu Matar (principal Sheikh of Jof) relented and himself took us on a seventeen hours' camel ride round the whole of the western portion.

From a hillock beyond Tolab we were able to take bearings of the dark mountains near Ribiana, and, at the point where this intersected the bearings taken from the biggest dunes on our route from Buseima to Hawari, we have charted this last oasis of the Kufara group. We were told by Hassan and Hussein Bazama, who visited us just before we left Taj, that Ribiana consisted of two villages, one at each end of a strip of palms 20 to 25 kms. long, bordered on the east by a salt marsh and a long garah higher than that of Buseima.

The Zawia is in the southern village. Having provided ourselves with a document like that given us at Buseima, we fixed our departure for January 23. We were very anxious to return direct to Jaghabub, but we had the greatest difficulty in persuading any of the retinue to go with us, for no caravan of less than forty or fifty camels had ever attempted this route, which was chiefly used by Sayed Ahmed esh Sherif and his Ekhwan. Nobody had crossed it for four years, and there was only one man in the place who would even attempt to guide us. This was an old half-blind Zouiya, one Suleiman el Beirish, a favourite of Sayed Ahmed. Generally, when a caravan travels this route the camels are fed up and rested for weeks beforehand. Ours were distinctly weak after the hardships of the last journey and only nine days' rest at Taj. Moreover, only eight were available, for we had decided to send the nine soldier-slaves back to Jedabiya by the main Zieghen-Jalo route, and we had to give them sufficient camels to carry their stores and water. Two more nagas were about to foal, so were useless. However, we managed to buy a large, strong grey Tebu camel, who proved to be the best of our caravan. This increased the number to nine, but two of these were three-year-old baccaras (young females), thin and weak.

The direct route from Awardel to Jaghabub means fifteen days' actual travelling, with only one well at Zakar, three and a half days from the starting-point. It is generally necessary to re-dig this well, as, though it is stone-built, it is so seldom visited that it is always filled with sand. It is necessary to carry camel fodder for the whole distance, as the only satisfactory grazing is at the Mehemsa dunes, two and a half days north-east of Zakar. Firewood must also be carried, as there is no hattab until the northern dunes are reached, four days south of Jaghabub. Thus it will be seen that the retinue had every reason for their fears. We knew that the only practical way was to travel very light, with the smallest possible party. Having got rid of our slave army, with Abdullah, and leaving Zeinab and Hauwa at Taj, there remained only Mohammed, Yusuf, and

Amer, all of whom had been most unfortunately depressed by passing a group of very recent skeletons, evidently a caravan which had died of thirst, on the way from Buseima to Kufara.

They wanted to look upon this as an omen, but we were determined to attempt the direct route, for two reasons. First, we wished to know more about the Hawaish mountains; secondly, if water could be found at the Mehemsa or stored in cisterns there, as was done when any of the Senussi family travelled that way, this should prove the main trade route between Wadai and Darfur, *viâ* Jaghabub and Siwa, to the Egyptian rail-head. In view of the low prices of hides and ivory in the south, and the strategic position of Kufara as the centre of the commercial web of the Sahara, with routes going to Fezzan, El Fasher, Abeshe, and Cyrenaica, the trade possibilities are considerable.

There is a twelve days' waterless route to Farafra, but we were told this went through bad dunes the whole way. We moved to Awardel on January 23, spent a day collecting firewood, grass, and date-fodder, and started north-west on a bearing of 345° on the morning of January 25.

At this point I should like to explain how difficult it is to get any definite information as to distance or direction from the Bedawin. The favourite answers to all such questions in Libya are, "There are no hours in the desert"; or, "As far as a man may go on one girba"; or, "Stick Jedi over your right eyebrow, and walk from dawn till you have put out Suhail."

Jedi is the pole star and Suhail the evening star. The more intelligent would say, "My walk is half a day, but I do not know yours." I may as well explain that the distance from Awardel to Zakar is, according to our calculations, 160 kms. as the crow flies; from Zakar to Mehemsa 128 kms.; and from Mehemsa to Jaghabub 420 kms. This means a total of 708 kms., or nearly 450 miles; but the last bit of the route (from Mehemsa to Jaghabub) could possibly be shortened, if the dunes would allow, by going more to the east.

Until we reached Zakar on the afternoon of the fourth day, we had been walking ten to eleven hours a day, but after leaving the well we marched twelve and thirteen hours. When we left Awardel we were much amused at the odd form taken by the farewells of our well-wishers. "If it is the will of Allah, you will arrive; but do not forget to 'agall' the camels at night," said Mahmoud el Jeddawi, with a mixture of piety and practical common sense. "If you lose the way you will either go to Siwa or to hell," said another sheikh, in a tone which left no doubt as to which he thought our most probable destination.

Our amusement dwindled as we looked at our little line of camels, for they were seriously overloaded. Four carried immense loads of date-fodder—a great leather sack on either side. Three were carrying water, as Suleiman considered it might take us a couple of days to dig out the Zakar well, if a big dune had blown down on top of it. Also we wanted

to test the new skins we had bought in the Jof market. This arrangement only left two camels to carry our food and luggage. However, the latter was reduced to a minimum; we had one small bag each, and the canvas bit of the tent was doubled up and used as a pack-saddle. For food, the Bedawin had just enough flour, oil, tea, and sugar to take them to Jaghabub, and we had eighteen small one-man ration tins and a dozen sardine tins, with a little rice, coffee, and tea, and some "buksumat" (dry, unleavened biscuits, flavoured with caraway seeds), given us by hospitable Ekhwan at Taj. We did not use a tent at night, but slept in wool-lined flea-bags on the ground. We were unable even to build proper zarebas with the luggage, as, in order to save time, we had to leave the loads ready coupled for the morning.

All our watches had stopped a month ago in the sandstorm at Jalo. Since then we had lived by Arab time, which begins one hour after sunset; therefore any estimation of hours can only be approximate. Yusuf used to wake us while the stars were still bright with, "Allah-make-you-strong are you ready for your ride?" all in one sentence.

Dressing meant extracting one's self from one's bag and putting on boots, baracan, and sash. It took us an hour to cook rice and coffee, breakfast, pack, and load. We were always away before the sun had risen. At night we used to walk an hour after sunset, unload, eat cold rations with cold tea—the latter because it was thirst-quenching—and crawl into our bags almost too exhausted to take off our boots. As we had to see the camels agalled and fed, it was generally an hour and a half before the one blissful moment arrived—that when one lay on one's back under the stars and knew one needn't move for more than eight hours.

From Awardel to Zakar we marched on a bearing of 345°. There was a cold north wind the whole time, the average noon temperature being 33° Cent., while at nights we had 3° and 4° of frost. The aneroid descended from 480 to 250 metres at Zakar well, which, being much the same level as the wells at El Atash, confirms the possibility of a low-lying, cultivable belt where water may be found with comparative ease.

For 16 kms., on January 25, we walked through red sand, leaving Ezeila, a small block of palms, and the low uneven hills of the Gebel Sarai el-Allagi on our right, and the two isolated groups of Gebel el Saraia and the Hawari Garah on our left. After four hours the pale sand began, mixed with a few stony ridges and irregular hillocks. For the first two days the Zakar route is so near the Zieghen one that one can pick up the landmarks of the latter. For instance, on January 26 we passed, east of the Garet el Ga'adiya, a small tabular hill, the Mohgen, a small hill shaped exactly like a tent or funnel, and the Garet esh Sherif, a bigger block. All these are near the Zieghen route.

That night we camped in the first line of the Hawaish mountains, having seen them ahead of us nearly the whole day. They are not really mountains, just steep Nubian sandstone hills of definite tabular or conical

shape, 100 to 200 feet high perhaps, with stretches of smooth sand, interspersed with patches of pebbles and rocky ground. It took two hours to get through the first range, but I imagine there is a straighter route. In some places there are wide gaps between the hills, and there is one definite pass. We had to avoid this because at the time we were being pursued by a band of robbers, who luckily passed us in the night as we hid in an unsuspected hollow. After leaving the first range of Hawaish there are 16 kms. of rolling sand, which gradually flattens into stony ground with stretches of black pebbles.

On January 27 we camped in the second range, and on leaving it the following day, we perceived a third range, of which it is probable that the rocky hills near Zakar are a continuation.

On January 28, leaving the second Hawaish range, we crossed very difficult country with enormous loose slabs of stone scattered about among stony mounds and shelves, with occasional hills which gradually gave way to wide-backed sand-waves, among which a black garah could be clearly seen beyond Zakar. These waves rise in the west to the dunes which lie across the Zieghen route for the first two days on the way to Kufara. They are not marked on our map, as we did not actually see them, but all the Bedawin told us of them, so it is probable that they are a continuation of the Buseima dunes, and that they sweep north of Zakar, where they are so bad that, to avoid them, travellers from Buttafal go to Hawari *viâ* Zieghen. We crossed them going to Mehemsa, but they were gradually getting smaller as they went further east. The line on the map represents what we consider their probable course.

Zakar well lies in a hollow among sand-waves, with rocky hillocks to the north-east. The well, which is 14 feet deep and only 2½ feet across, is marked by two clumps of palms, and there is a little thin grass in the immediate neighbourhood, but no firewood. We arrived at 2 p.m., and spent the afternoon digging out the well, which was covered by mats and skins, but the sand had percolated through these so that the well was quite full. A very bad sandstorm raged all next day, and we could not move. The noon temperature was only 16° Cent., and the air was solidly grey with flying sand. Towards the evening it abated, and we were able to water the camels, but they would not drink properly.

On January 30 we started on a bearing of 60° in a cold north wind which strengthened to a sandstorm about 10 a.m. It took us an hour to cross the rocky ground between sandstone hills, and then, quite suddenly, we mounted a stony bank and looked down on a sea of waving white dunes stretching as far as the eye could reach in every direction. As we moved across them, the flying sand filtered through our clothes, stinging and cutting us. It was the most terrible day conceivable, but, having started on our twelve marches, we could not stop till we had done 50 kms. If we walked we were smothered in sand which half blinded us and choked us. If we rode we were almost blown off the camels. If we lay

down exhausted for a few minutes, while the caravan staggered after us, we were nearly buried in the sand. We lost all count of time, and it seemed the middle of the night when Suleiman finally stopped, and we lay down to sleep just as we were, without eating or taking off our boots.

Next day Nature evidently wished to show us a llthe horrors of which she was capable, for it was torrid, without a breath of wind, and a noon temperature of 50° Cent. For 12 kms. the dunes continued. Then we came to uneven, stony country, where Suleiman pointed out traces of what he said had once been human habitations. They looked to me more like natural sandstone formations, but we were assured that several prepared milling-stones, with holes drilled in them, had been found there. The Mehemsa dunes were to be seen at noon: the golden mountains of sand rose sheer out of the dark stones which went right up to their base. We reached the dunes just as night fell, and camped under them.

Next day we followed the southern edge of the chain for 26 kms. Then we turned north across a low ridge, and found the Mehemsa hatiya on the other side. The hatiya consists of a long faint hollow, a kilometre long, filled with mounds thickly covered with a dry, grey bush with juicy pods beloved of camels. Two kms. further on, beyond a wide stretch of flat sand, crossing a curve of the dune belt, we came to another hatiya, larger and full of the same bushes. A few kilometres east of our camping place there was a hut and some large empty reservoirs (I saw two, but was told there were three) used by Sayed Ahmed for storing water. We spent the afternoon in this second hatiya, hoping that the camels would get a good feed, but it was so hot that they were disappointingly uninterested in the fodder. The young baccarats were looking very thin indeed, and it will always be a matter of amazement to me how those nine camels achieved the trek. We had started with twelve girbas and our three fanatis, which later we had sealed up to keep to the last days. Three of the girbas had leaked away or been dried in the sandstorm, and the remainder were very slowly and gradually drying up, so we limited ourselves to the old allowance of four small cups per day. Unfortunately the girba water was very bad. It was black or red and, after a few days, tasted bitter and smelt horribly. Our morning rice was black and gritty, mixed with girba hairs, and altogether most nauseous. The aneroid registered 280 metres at the Mehemsa, but it was either lost or stolen immediately after we left the dunes. For three days we walked across unchanging flat sand covered with minute brown gravel. It was utterly featureless and without any form of vegetation, like the great Serir between Buttafal and Taiserbo. We marched due north.

The third day the early morning mirage showed us for a few minutes a line of dunes ahead, but we did not see them in reality that day. The fourth day the "upside down country" appeared much nearer, and, though the mirage faded about 8 a.m., we saw the real dunes on the northern horizon two hours later, while west of us appeared a long ridge of

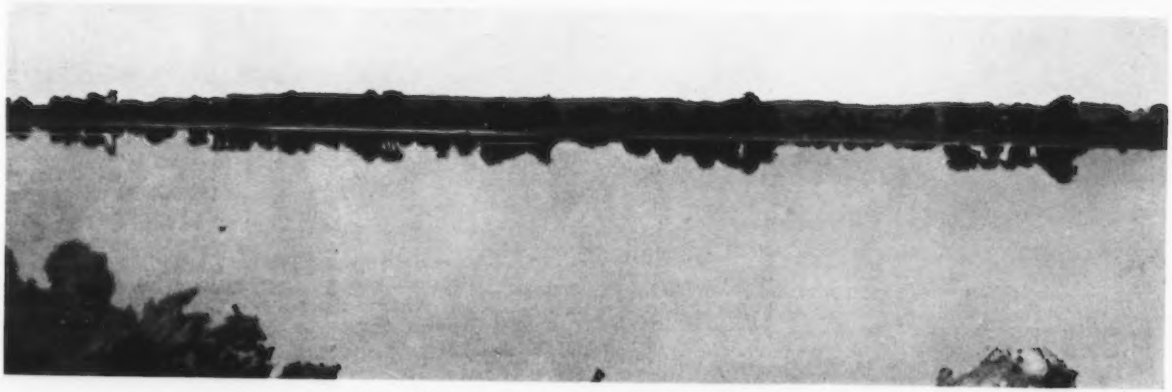
sand running south to north, called the Mazul. We entered the northern dunes at 4 p.m., and found that behind the first big peaks there was a broad open space wherein we camped that night.

The fifth day (February 6) we found the dunes ran chiefly in large ranges north and south, with flat spaces in between and occasional smaller waving ridges crossing these. We found a little dry hattab in the hollows.

Next day the dunes were closer, and there was some green fodder in isolated tufts. The seventh day the dunes rose to their highest, and the green fodder increased, but by this time the camels were so thirsty that they would not eat while the sun was hot. There was no prevailing wind. Since leaving Mehemsa we had had a north-west wind, a southerly, a south-westerly, north-easterly, and an easterly. The highest noon temperature (on February 3) had been 52° Cent., but at night there were 1° to 4° of frost.

On the eighth day (February 10) there was much green hattab among the dunes, with tiny stunted trees 2 or 3 feet high. We saw large trunks of fossilized wood, patches of black stones, and great blocks of the grey Jaghabub sandstone. We also came upon gazelle tracks, and at noon, from the top of a high dune, we could see the end of the sand, and the beginning of the grey, stony country, which looked black by contrast. All along the northern edge of the dunes lies a belt of hatiyas, not entirely continuous, but most of them known by name and recognizable. We came out of the sand some 8 kms. west of Bir Alia, on the Jaghabub–Jalo route. This meant nearly a day and a half's journey west of Jaghabub, but our guide had been determined from the beginning to strike west rather than east. In vain I urged that it would be wiser to go east on the ground that if we missed Jaghabub we should find ourselves on the Siwa road, for there is a clearly marked and well-known track between these two places. Suleiman insisted that Jaghabub was exceedingly difficult of approach from the south-east because of the "Sabakhah," rough salt land, and he plodded determinedly towards the magnetic north until, about three hours after starting on February 9, faint blurs of indigo on the far horizon caused him to turn north-east. The Bedawin always speak of "seeing land" when, after a very long trackless journey, they recognize any known country. By the time we definitely "saw land" on our eleventh day from Zakar, we were all too exhausted to show much interest. The camels were, I believe, the least weary of the party. I remember Hassanein Bey and I started a discussion as to how many different aches the human body was capable of feeling at the same time, but we were both so tired that we had not even energy to talk. I found it easier to walk with my eyes shut, shuffling along monotonously in heel-less native boots (yellow with scarlet thongs), trailing my stick after me till I dropped it and was too utterly worn out to pick it up again. The one blessed moment of the day for me was when the sun was just setting and one could let the intolerable weight of the barracan slip off one's head. Since the sandstorm at Zakar our

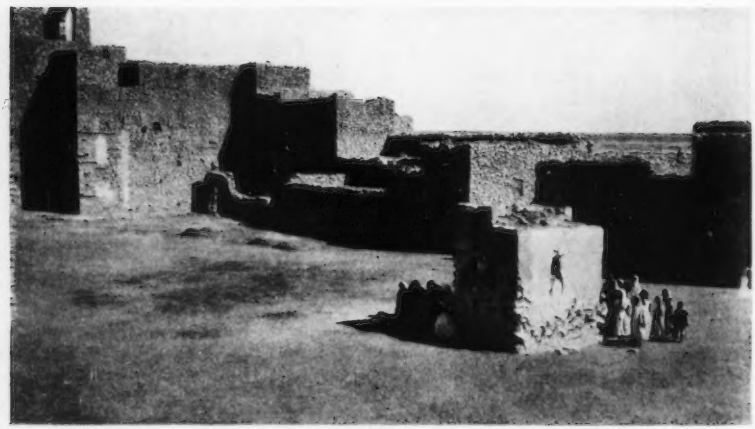
MIDDLE OF THE KUFARA DEPRESSION FROM TAJ



THE LAKE AT BOEMA, KUFARA DEPRESSION

A DESERT CAMP

THE ZAWIA AT JAGHABUB



WELL IN COURT OF ZAWIA AT JAGHABUB

nights had been tortured by acute sand-rash. For twelve days we were not able to wash even our finger tips, and, as every pore was clogged with sand, inflammation set in, so that we could scarcely endure the heat and restrained space of our sleeping-bags. This meant that we had practically no sleep after a thirteen hours' continual march. However, the eleventh night, having passed through the hatiya of Bir Alia, some 16 sq. kms., where is the famous Garet el-Mahdi, an immense tabular rock beneath which the Senussi Saint used to worship before setting out on his journeys, we camped at Bu Salama and riotously wasted the last of our water in baths in the canteen lid! Next day, without troubling to re-dig the closed well at Bu Salama, we went on to Jaghabub through strange country of distorted sandstone hills and banks. Generally the top layers were reddish, and these dripped over round white bases polis'..d and chiselled by the wind so that they looked like tables, altars, or mushrooms, according to their shape.

After 30 kms. we arrived at the escarpment above Jaghabub and looked down 200 feet into a vast natural amphitheatre, its uniformity broken by tabular sandstone hills and cliffs. Beyond these lay the white dome and white walls of Jaghabub, with two tall windmills on the west and a gap to the east where the wadi runs out towards Siwa. Immediately below us were scattered palms, but the main block of cultivation is to the north of the Zawia, where there is a single large well which provides water for the college and for all the gardens owned by freed slaves of the Mahdi.

We were most hospitably received at Jaghabub by Sidi Hussein, the Wakil of the Emir Idris, and for three days we lodged in the house of Sidi Yadem Bu Gemera, one of the principal Ekhwan, inside the largest court of the Zawia, opposite the main door of the mosque. Jaghabub is not a town in the literal sense of the word. It is merely one large Zawia, inside whose solid mud-brick walls are clustered the houses of the Senussi family and of the Ekhwan, with the large and beautiful mosque of Sidi Ben Ali, his qubba, and the tombs of several members of the family. Round the mosque are various white courts with rows of neat little wooden doors, behind each of which lives a student with two rooms to himself. Jaghabub is not a political or mercantile centre like Kufara or Jalo. It has all the dreaming peace of a little university, only its Dons are reverend, grey-bearded sheikhs in flowing white jerds over grass-green or indigo-blue robes; its under-graduates are graver figures, with their rosaries and Korans, than those of Trinity or the House; while the scouts, I suppose, are the black slaves of hideous aspect who live in a special court of the college. Outside the intricate mass of buildings of which the Zawia consists, are only two large houses, and the total population cannot be more than 150. It will therefore be seen that the Jaghabub of to-day is very small, and it is almost impossible to believe that it had ever the importance assigned to it by Henri Duveyrier, who,

while it was the headquarters of Sidi Ben Ali es Senussi, described it as fort, arsenal and factory, as well as barracks, court and college.

I think the account of our Kufara journey may well end at this remote white town in the wadi, for the 80-mile route from Jaghabub to Siwa has been most ably charted and described by various members of the light car patrols, who penetrated as far as the escarpment overlooking the town. No European has entered the Zawia, but an Italo-British Mission to Sidi Idris, under Major Arcari and Major Bramley of the Frontier Districts Administration, camped within a quarter of a mile of the white dome, whose latitude and longitude have been fixed by a distinguished member of the R.G.S., Dr. John Ball, Director of the Desert Surveys of Egypt.

To the most generous and patient assistance of this same energetic geographer I owe the first maps of my Kufara expedition. When he adjusted our traverse he found that there was an error of 20 miles in the closure on Jaghabub. As the total distance traversed between Jedabiya and Jaghabub was 1009 miles, exclusive of the tour round Kufara Wadi, it was considered best to distribute this error of two per cent. over the whole journey.

Before the paper the PRESIDENT said: Mrs. Forbes is one of those who possesses the true spirit of travel, for though, as far as I can judge, she is not extremely advanced in years, she has already travelled over a greater part of the Earth—in India, China, the South Seas, the Malay Archipelago, and in Syria and North Africa; and she is now to give us an account of that very adventurous journey to the mysterious headquarters of the Senussi at Kufara in the Libyan Desert. The numbers who have come here this evening are evidence of the interest with which we shall listen to the tale she will unfold of her remarkable journey.

Mrs. Forbes then read the paper printed above, and a discussion followed.

General Sir GILBERT CLAYTON: I find it difficult to say very much after the lecture to which we have just listened; but I have done a certain amount of camel-riding about that kind of country—enough to know what it means to have done what Mrs. Forbes has done. She has given us a very interesting lecture, full of humour, that may perhaps have misled some people who have not been in the desert; but I think those who have will realize it is that sense of humour that has carried her through, because without it I do not think she could have done it. Ahmed Hassanein Bey I know very well, and all she says about him is very fully deserved. I think our Society will be a very great gainer by this journey. All the technical part of it has no doubt been worked out, and Mrs. Forbes has added a great page to the history of Central Africa. That country was completely unknown heretofore, and all sorts of surmises have been held. Now we have a very fair idea of what really is there, and I think the bogey which was held up before us in days gone by is somewhat exploded now. I do not think there is any very great danger from there, but it is country which is extremely interesting, and we all owe a debt of gratitude to Mrs. Forbes for putting us wise about it.

Dr. HOGARTH: I am no authority on Kufara. In fact, there is only one authority present, and that is Mrs. Forbes. Like Sir Gilbert Clayton, I was conscious that with her sense of humour she was making light of what were

at times horrible, and might have been tragic, experiences. There are not very many places which are surrounded by seven days of such waterless march as the oasis of Kufara, and it is rather its ring of extraordinarily forbidding desert that has kept it secret than the fanaticism of its people. At the same time there has been, for a long time, among that people a firm determination not to be interfered with by Europeans or anybody who has had touch with Europeans; and during the reigns of at any rate Moh. Idris's three predecessors, it was, in fact, impossible to go to Kufara unless you went with the strength which Rohlfs had when he first started out in 1879; and even so he made no very great success of it. Now Mrs. Forbes has done this impossible thing; and we congratulate her very warmly on a most remarkable adventure, in which she has shown equal courage and physical endurance. I am sure she would like me to include in our congratulations her companion, Ahmed Hassanein Bey, whom I knew fairly well during the war, and of whom I have a very high opinion. Nothing has convinced me more of Mrs. Forbes' strength of character and power of drive than that she induced him to travel to Kufara. I believe he was of enormous assistance, both in the going and while there; but I am quite sure that the initiative and motive force came from Mrs. Forbes. She has wiped Kufara off the list of places that have not been visited; and I dare say it will not be very often visited in the future. The Italian Government will hardly think of laying a railway through that desert to an oasis which contains less than three thousand inhabitants; nor do I see why the trade which used, to a certain extent, to go up north through the Sahara desert should ever revive sufficiently. These routes were always terribly painful, long, and difficult. They paid only for very expensive commodities, such as feathers, ivory, and human flesh, that is to say, slaves, and it is the opinion of many who know the economy of North Africa that, as the slave trade is now not smiled upon, even by Turks, it is very unlikely that the old caravan routes across the Sahara will ever recover the volume of trade they carried in the past. If that is so, Kufara will be as little visited in the future as in the past, and Mrs. Forbes will probably remain for a good many years the principal authority upon it. After hearing her to-night, I feel there is very little more for us to learn about Kufara. She has fulfilled the first duty of an explorer, which is to go to a place and leave nothing for anybody else to do.

Colonel Sir ROBERT SANDERS: I think what most of us feel is that we ought to congratulate Mrs. Forbes not only on what she has gone through, but on the fact that she is here at all. I cannot speak with the experience of the last speakers of the desert, but I did see something of it when I was out in 1916 in the Kharga oasis, which appeared in the south-east corner of the map. I was waiting there for some time while we were trying to get on to the Dakhla oasis 80 miles to the west. Very few of us went into the oasis because the Senussi went away before we got there, and the only ones I saw were those who were taken prisoners. But when Mrs. Forbes writes the book, there are one or two things I hope she will tell us, and which I was waiting to hear about to-night. I wanted to know why her friends were our enemies at that time, and why it was they joined in, at rather an inconvenient time, against us. The other thing was, what was the fauna of the Kufara oasis? The enemies with which the British troops had to fight did not consist of Senussi alone. I think the fauna of the districts, especially the flies and the mosquitoes, was responsible for quite as much sickness, if not for as many deaths, as any Senussi or other enemies that we met on the western front of Egypt. From the description given us of the Kufara oasis, I should certainly be inclined to concur

with what was said by one of the previous speakers, that it is not likely to become a place much frequented by Cook's tourists. Now it has been found, it does not appear to be of much use to us. I do not, however, think that detracts from the glory to be attributed to Mrs. Forbes for having found it. She found it because she wanted to find a really interesting thing, and that is the true spirit of the geographer. I can only thank you for having asked me to be here and giving me the opportunity of listening to the most interesting lecture I think I have ever heard in my life.

Major R. B. BURNEY: I must at the outset confess that I did not reach Kufara, but that I only got as far as Siwa and a little beyond. We were, as a matter of fact, forbidden to go either to Kufara or Jaghabub, and entered into an arrangement with the Senussi to keep 15 miles from either of their holy cities. But we did get to all the other oases which were occupied by the Senussi, and finally the attack of the Duke of Westminster broke their spirit. Perhaps I may describe a little portion of that campaign. We attempted, first all, to get to the Bahariya oasis, but it was difficult on account of those physical peculiarities already described by Mrs. Forbes. Its approach was guarded by large sand-dunes, and the Senussi had a way of being behind a dune when you least expected it. We did, notwithstanding the last speaker, attempt to construct a railway to this oasis. We first of all camped at Samadut, and from there went to Shusha on the borders of the desert. From there the General (whose name I do not think it would be fair to mention) started a railway over 160 miles in length, and the speed at which we travelled may be calculated when I tell you it took us two days to get to the end of it. After an enormous time taken in building this railway we got to the oasis, completing the journey by camel train, only to find the Senussi had fled before us. With this experience it was not surprising that some more effective and less costly method should be attempted, and the famous dash was the result. The efficiency of the armoured cars having been fully proved, we gave up crossing the desert by camel, and I crossed in comparative luxury in cars. We carried cisterns containing twelve gallons of water, and reached a luxurious ration of a quarter of a gallon of water a day each. Still, for all domestic purposes that is not a large allowance. Of course all our journeys were not made by motor car: there were some we made by camel precisely in the same way as described by Mrs. Forbes, and very slow affairs they were. There were one or two peculiarities in some parts of the desert I think specially worthy of notice, the first of which is the enormous number of snails. They formed the staple diet of the unfortunate officers in the hands of the Senussi, and lie so thickly strewn on the ground as to give the appearance of a light snowstorm. Over the coast there is a very small green leaf, which I dare say Mrs. Forbes noticed, which springs up in the night; and more rarely a magnificent lily that grows up in the night too. But both have gone an hour after sunrise. Another striking feature is the extraordinary quantity of sea fossils, of which I have a considerable collection. There they lie precisely as they were in those remote ages when the sea covered the sand that is now a burning desert. This exhibit which I have in my hand is a silver band which is worn by the young girls. When a maid gets married the disc suspended to it is removed and cast into a well. These are two bracelets stamped with the value and made out of the silver coins which circulate freely in the desert. Turkish coins, and more especially Austrian thalers, are melted down and made up into these and similar articles, and it is a strange fact that the Bedawin have not yet tumbled to the idea that the melted dollar is not equal to the face value of the dollar.

These ornaments are stamped showing the number of dollars from which they have been melted. Among the peculiarities of the desert are the curious rock stacks to which Mrs. Forbes has referred. They consist of a very hard limestone, but hard as that is, the wind and the sand constantly blowing against them has worn them into most beautiful and fantastic forms resembling those to be seen in ice on the glaciers in Switzerland and the Rocky Mountains. But these of the desert are the result of centuries of air and sand friction, and the beautiful feathery forms are formed from so hard a stone that it is almost impossible to break them off. I have seen rocks embroidered in a kind of petrified lace, and only on one occasion was I able to break off any piece of it with my hand. It seems probable that Mrs. Forbes came originally from the desert. She has shown so great an acquaintance with its ways and spirit that that conclusion is irresistibly forced upon one and supported by that great desert traveller Herodotus. He speaks of a people whom he called Hyperboreans, distinguished from other races by their enduring beauty and everlasting happiness. I trust that the happiness may follow.

Mr. W. J. HARDING KING: It is ten years since I was in the Libyan desert, and while there I heard a great deal about Kufara, and it has been very interesting to see photographs of places I have heard of shown by Mrs. Forbes. With regard to the routes to Egypt from Kufara, I think the best one is that used by the Senussi themselves. I once followed the tracks of some of their couriers going there from Dakhla, and found that they went for one day to the south, and then turned off due west over a high sandstone plateau, and so far as I could see there was no difficulty on that road due to the sand. Of course north of that route you have an enormous field of dunes almost impassable by a large caravan, but practically all this sand is banked up against the north of this plateau. I think the best way into Egypt from the Central Sudan is to avoid Kufara altogether. There are the remains of a road from Dakhla going to the south-west, which runs to a place called Owana, which lies halfway along the road from Kufara to Merga, and so is about 180 miles south-east of Kufara. I have been almost within sight of that place. I have been near enough to see that the whole of that road is entirely free of sand, and Owana itself can, I think, be reached without difficulty from the Central Sudan by way of Terkaz, Demi, or even Tikeru. This road would be very much shorter than that *viâ* Kufara, and would entirely avoid the extremely difficult dune-field lying to the east and north-east of that oasis. Moreover, if once you can bring a caravan up into Dakhla, you will then be quite close to the railway in Kharga oasis, which could be extended without difficulty into Dakhla. I should like to thank Mrs. Forbes for her paper, and to congratulate her on having been able to come back and read it.

Mrs. FORBES: May I reply to two points in the discussion? I have seen no lilies in my part of the desert, and if there had been my camels would have eaten them. For Dr. Hogarth, when the trade route is opened up, shall be reserved the prettiest little slave!

The PRESIDENT: The point in Mrs. Forbes' lecture which most struck me was her account of that very remarkable flat part of the desert which I had asked her to describe, but which even she found difficulty in picturing to us. I have seen many deserts in Central Asia, but nowhere have I seen anything so absolutely flat and smooth as that part of the desert which Mrs. Forbes described as being like a "gramophone disc." She told us how she saw in front of her nothing but a complete circle, the edge of which was apparently the end of the world; and I gathered that on the other side we might look

down into hell! That an English lady should have been able to endure these extreme hardships, and to have shown so much tact and perseverance in overcoming not only physical difficulties, but also those human obstacles which are generally the greatest impediment in the way of travelling, is a matter of particular congratulation. And we who have listened to her this evening must not only congratulate Mrs. Forbes upon her great pluck, energy, and spirit, and the long foresight with which she planned out this remarkable journey, but also upon the admirable manner in which she has described her journey to us. On all these accounts I know you will wish me to convey to Mrs. Forbes an especially hearty vote of thanks for the extremely interesting paper which she has given to us.

TRAVELS IN TURKISTAN 1918–20

Captain L. V. S. Blacker, Q.V.O. Corps of Guides, Punjab F.F.

Read at the Meeting of the Society, 2 May 1921. Map following p. 248.

Part 1. A Mission to Kashgar.

A WORD of explanation will be needed to account to you for the presence of His Majesty's troops in Central Asia. That takes us back to the autumn of 1917, when Falkenhayn's "Yilderim" army wavered in his hands, and the German higher command saw that the Byzantium–Baghdad–Basra line, and its goal at Bombay, were for ever out of their grasp. The cry of "Pan-Islam," too, had made no impression on the loyal ears of Punjabi, Maroccan, or Lesghian, and the fertile brains of the C.U.P. were instructed to find a new one. Though checked in the deserts, in Arabia, Iraq, and Iran, yet a certain success had crowned enemy efforts to spread the taint of treason in Moscow, and their thoughts turned to Turan and to the steppes.

Islam had spurned the Prussian, so his vapid psychology took him back to Attila, his forbear, and to the monstrous iniquities of Tamerlane and Ghengiz Khan. His strategists pondered over Batum, Baku, and Bukhara; his secret agents spoke in the caravanserais of the spacious days before Mahomed brought a civilization, while Afghan cities filled with Osmanli drill-sergeants and Magyar gun-layers.

The Red Terror, nourished by German trade agencies, had laid hold of Tashkent and spread over all the Russian dominion in Turkistan, where 180,000 Germans, Austrians, and Magyars had been confined in their prison camps. Amongst these were the men that had been the garrison of Przemyśl. In October 1917 all were "comrades," so of course there could be no prisoners, and the kindly Soviet opened the gates in the barbed wire and discontinued the ration issue. Ninety thousand ex-prisoners of war died during that winter. Many of the survivors joined the Red Army, some fled to Afghanistan, and some worked for, or starved with, the easy-going Kirghiz and Sarts.

All this the German turned to account. In Afghanistan he formed the "Imperial and Royal East Indian Detachment"; in Turkistan, missions, under various cloaks, organized the surviving prisoners into battalions and brigades, gave them good new uniforms and boots, and tried to smuggle trained specialists to Afghanistan. In 1918 Turkish troops had penetrated into the Caucasus, and a German Army Corps was earmarked for Baku, which indeed it reached. It could from Baku be railed to within five days' march of Herat, or to within twelve days of Kabul. The hordes of the steppes, so hoped Enver, who now imagined himself a second Hulaku Khan, would pour at his bidding to the passes of the Hindu Kush, and then German, Turk, Austrian, Afghan, and Tatar together into the fertile plains of the Sutlej and the Ganges.

It was a fine dream, and a prosaic modern touch was lent by the three years' cotton crop of Ferghana and Sir Daria, many thousands of tons, that the enemy desired to transport into Germany to be made into propellants, either through Baku or else by way of Orenburg and Moscow. This vast store of cotton now lay rotting in the warehouses of Turkistan, or served as bullet-proof protection on Bolshevik armoured trains.

In early 1918 all these matters were hidden from us, or only discerned dimly across the great spaces of deserts and ice-bound mountain ranges, over which even the hardy Central Asian trader now seldom came. Information was essential, so three missions of widely different size were dispatched. From Baghdad General Dunsterville set out on his venture to the Caspian that he has so well described. Through Baluchistan and up across the 700 miles of East Persian desert went Sir Wilfred Malleson's Mission; whilst our own party, the smallest of all, trudged up in March and April 1918, over the northern passes of Kashmir, through Gilgit and Hunza, to come under Sir George Macartney in Kashgar, in Chinese Turkistan.

The Mission comprised three British officers, not including Sir George himself, whom we were to meet at Kashgar, and sixteen soldiers, of whom all but two belonged to the "Q.V.O." Corps of Guides; the two were riflemen of the Royal Garhwal Rifles. It was most appropriate that the Guides should have furnished nearly all the soldiers of the mission. As long ago as 1873 a troop of the Guides Cavalry and a platoon of the Guides' Mounted Infantry had crossed the 18,000-foot Karakoram Pass, and penetrated with Sir Douglas Forsyth to Yarkand and Kashgar, then ruled by Yakub Khan, the Atalik Ghazi, who had expelled the Chinese and annihilated their garrisons. This little force traversed all Eastern Turkistan, even making its way into the then unknown region that is now called Semirechia and into the Tian-Shan.

Our little band packed themselves into a few lorries at Rawalpindi, and in two days reached Srinagar. We crossed the great Wular lake in boats, and the real journey began. It was now April and the country was all under snow, and in these conditions the Tragbal and Burzil passes

were not too easy to cross, even at midnight. We were fortunate not to encounter any avalanches, and sixteen days' chilly marching took us to hospitable Gilgit. Our baggage required no less than 180 porters, who consequently had to move in three separate columns, a day's march apart.

In Hunza we met with a real full-blooded welcome from His Highness the Mir and all his hearty lieges. We crossed the Mintaka Pass on to the Chinese Pamirs accompanied by a Hunza escort, with whom our Regulars had established very friendly relations. At Tashkurghan we met some of the 6th Orenburg Cossacks, who were holding that post on their own account, carefully ignored by the Bolsheviks.

These Orenburg Cossacks are a fine hardy lot of men, and we had met before in 1914. My regiment has been stationed for nearly eighty years in the most northerly cantonment of the Frontier Province, and the 5th and 6th Orenburg Regiments have for many years been just opposite across the frontier, only a few ranges of hills away. Consequently the regiments have seen a good deal of each other in the past, in remote valleys of Central Asia. On this occasion we were allies, and the fact was celebrated with junketings.

Next day over in the Chinese fort we dined also with the Chinese Amban, who holds both military and civil charge of the Chinese Pamirs, and then pushed on towards Yangi Hissar and Kashgar over the passes of Kök Moinak, Kizil Dawan, and Kara Dawan.

We had employed yak transport from the south side of the Mintaka instead of porters, and now all hands were mounted on the little shaggy Kirghiz ponies. This track is that usually taken when the Gez defile is blocked by floods. It is in many places very rough, and the passage of the Tangitar gorge is no easy matter. For miles one fords the torrent every few minutes and clambers over rough boulders. At last after several days we came out into the wide valley of Chong Kurghan that opens on to the plain of Turkistan and the Takla Makan desert.

In due course we reached Kashgar by way of Yangi Hissar, meeting with a sumptuous reception from the Chinese authorities at each place. Our host at Yangi Hissar was a Chinese Mahomedan Colonel, Ma-Tung-Ling. He made us at home in his yamen, hung with texts from the Koran painted in the Chinese fashion in curiously Chineseified Arabic characters in black on red paper and silk scrolls. Phlegmatic as the Chinese are, their officers could not refrain from commenting on the bearing and turn-out of our detachment and on the handling of their arms.

It soon became clear to us even in Kashgar that the Tashkent Bolshevik Soviet was a power in the land. The first revolution had passed off almost bloodlessly, but a reaction set in. The Orenburg Cossacks, under Ataman Dutov, had achieved much success against the Red Army in 1918 in the steppes north of Tashkent, and in March, as far as I can remember, they attacked the city, aided by the cadets of the Military College. They soon defeated the Bolsheviks, but some evil

THE EAST PERSIAN DESERT

MARKET AT BAIRAM ALI: RUINS OF OLD MERV IN DISTANCE

HILL OF PANJ MAND ON THE TRACK FROM MESHED TO KELAT-I-NADIRI

INTERIOR OF KELAT-I-NADIRI ON MISTY DAY, LOOKING NORTH TOWARDS DARBAND-I-NAFT. JA-I-GUMBAZ IN MIDDLE DISTANCE

genius prompted them to put themselves under the command of a lawyer. Hence the Soviet very soon turned the tables on them, and they lost the city, though they retained a hold of the Orenburg Railway that connects Moscow with Tashkent. This circumstance was of no little value to the Allies, since it prevented the Turkistan cotton crop from being sent to Germany by that route. In fact, the operations of this loyalist army of Orenburg Cossacks form a fine chapter in the story of the war, and one that has not come into the limelight. For three years this force of Ataman Dutov's, averaging some seven thousand strong, often without ammunition, fighting with swords and lances, held its own against the Red forces all round them. They were quite isolated from Allied help, and in fact from any other loyal force, except for the brief period when they were in touch with the army of Admiral Kolchak, himself a Cossack.

Meanwhile the Musalman of Tashkent, Kokand, and Bukhara revolted against the Soviet. In all three cities the rising was suppressed with great slaughter. Kokand was razed to the ground by high explosive shell-fire, and thirty thousand souls were reported massacred: it had been one of the greatest commercial cities of Asia. In Bukhara one Kolesov used armoured cars in the crowded streets, which ran with blood. Although the Reds gained control over the city, to this day they have little or no hold over the country districts, where large bands of Uzbegs and Kipchaks roam the valleys, maintaining a guerilla warfare against any Bolshevik force that leaves the railway and the guns of its armoured trains.

In June three British officers of the Mission, under Sir George Macartney, left Kashgar for Tashkent. A motor bicycle, brought up from India packed in six loads, was used here for the first time, from Kashgar up to the Kizil Dawan in the Tian-Shan. We spent practically three months in Russian territory, and Sir George has himself described the episode in the *Central Asian Journal* of June 1920.

In Turkistan five wars were being waged against the Bolsheviks: by the Orenburg Cossacks on the north; by the Semirechensk Cossacks in the east; by several thousand Uzbegs under Irgash Bai and Mahomed Amin Beg in Ferghana to the south-east; by the Turkman under Oraz Sardar in the south; and by the Ural Cossacks on the Sea of Aral.

To crown all, during the week in which we arrived in Tashkent, three companies of the XIXth Punjabis joined the Mensheviks coming from the south-west and made our situation still more hopelessly involved. The Soviet were worried and showed a tendency to hold us responsible for their troubles, especially in the matter of the XIXth Punjabis of General Malleson's force. However, we had a more or less plausible explanation for everything.

The Mission, under Sir George, returned towards Kashgar when its work in Tashkent was completed, crossing the frontier into China in the end of September. We did not touch Kashgar, but eluding certain

Bolshevik efforts at Andijan, Osh, and Gulcha, travelled on to the Pamir over the Terek Dawan, now under snow, and thence by a goat track over the hills to Kök Su and into Chinese territory at Irkeshtam.

At Irkeshtam we found a number of loyal Russians in the Customs post on the Russian side of the frontier, and two Bolsheviks in the telegraph office up the hillside. We outnumbered them and had no trouble. From here we took a little-known track leading down the Kizil Su valley on to Opal and Tashmalik, and were able to make a few topographical notes and to write a description of the route.

At Tashkurghan exciting news awaited us. A gang of two hundred Germans, Turks, and Afghans had been seen by a merchant crossing over from the Great Pamir north-eastwards towards Yarkand.

This news was for us the forerunner of seven weeks' desperate marching over unexplored snow-bound ranges in the kit we stood up in, and, at times, on the shortest of short commons. In view of the reported strength of the enemy we called in the detachment of the 6th Orenburg Cossacks at the post to help us, and with our force made up to some fifteen rifles, pushed along at dusk down the wild gorge of the Tashkurghan river where it plunges down from "high Pamere" to the great plains. It was a nightmare march, for up to three in the morning the men and ponies were clambering along the face of cliffs that would have been difficult in broad daylight. Some extraordinarily good luck favoured us, and we made the wretched hovels of Shindi without any broken bones. There was no trace of our party here, and the gorge lower down to the north-east is impassable for man or beast, so after five hours' sleep we pushed south-eastwards up a pleasant valley to Wacha, where there are one or two hamlets and some grazing-grounds of the Aryan Sarikolis. A track goes from here to Sherhus, lower down on the Tashkurghan river, but it is so dizzy that even the Pamir Tajiks have to be led over it blindfolded by the local people.

At night we all rendezvoused at Wacha, having found no trail, and had a good and much-needed feed off a fat Pamir sheep seethed in a great pot, into which every one dipped his fingers. Next day we crossed the Sarikol range by an unmapped pass near peak 18,550 and struck the Taghdumbash valley again. We left the Cossacks watching the Mariong Pamir in case anything might turn up. At Dafdar we struck fresh news. Fifteen mounted armed men had come over from the Russian side, across the Sari Kuram pass, had passed through the hamlet at midnight, and a lonely shepherd had seen their tracks in the untrodden snow of Ili Su. We pushed on up the desolate Oprang, collecting seven rifles of the Hunza Company of Scouts from Payik, and (thanks to Sir George's efforts) an indispensable pony-load of flour, which was to be our sustenance for a long time to come.

Up in the Oprang we plunged into the blue. Snow was falling and the ponies' feet made no sound. Ahead of us lay the hugest mountain rampart in the world.

After dark we came to a couple of small ragged yurts in the gorge of the Ili Su, and found two Kirghiz damsels who made us welcome and confirmed the news of the party we were after. Next morning snow was still falling, and we, bipeds and quadrupeds, had a tough scramble over ice-sheets and cliff faces to the top of this pass of Ili Su. Sven Hedin, as he describes in his book 'Through Asia' (vol. 1, p. 686), tried to cross it, but turned back. On the crest, about 17,000 feet, the sun came out and our eyes were gladdened by unmistakable tracks in the snow of the north slope. We hurried on down, finding more tracks, and bivouacked in the snow under a cliff and some boulders. All next day we struggled down this abominable steep and rocky valley, having latterly to push through close-knit thickets. We came also upon a broken tea-bowl marked "Made in Japan." The fracture was new, and it was too good to have belonged to some wandering shepherd; it must have come from Afghanistan.

Sometimes one or two Tajiks come down to a spot here called Issik Bulak, where is a hut and some traces of ploughing. We found a couple of yaks here that were most useful as mounts. Then dropping out of the snow we bivouacked alongside roaring brushwood fires in a glade called Baital Jilga, where we found a new empty cartridge case. We had now got to know the tracks pretty well from gazing at them some fourteen hours a day, and could identify the various horses that the enemy rode from their hoof prints. Next day was memorable, for we came down on to the mighty Raskam itself. For a short time we were racked with uncertainty. Were the tracks going to lead up the valley to the east, whither we would have to pursue for hundreds of miles through the desolate wastes of the Raskam and the unexplored Kara Kash towards Khotan, and to Lop Nor and possibly even to Shanghai?

It was known that von Hentig, a justly celebrated German emissary, had a year before made a similar journey from Badakshan, and we reckoned ourselves to be on the track of some one of the same kidney. The trail led down to the water's edge, and we just managed to cross the swift river. It was a touch-and-go business, and only the standing luck of the British Army saved several drownings, or, what would have been just as bad, the loss of some rifles. We had become so hardened to cold after weeks of the wintry Pamir that the stripping off of our clothes to struggle through the Raskam seemed like a pleasant sun bath, though the month was November and the altitude 10,000 feet. The trail led slanting up the great stark slope of the mighty Kuen-lun, and when we panted for breath at the summit of the Tupa Dawan a most wonderful view unfolded itself. To the south the mighty snow-peaks of Muztagh, Oprang, and Hunza; to the east the desolate Karakoram; to the north ridge upon stark ridge unrecognizable from the vague map; to the west we looked down into the untrodden gorge of the mysterious Raskam, flowing between sheer cliffs towering 7000 feet from the water's edge.

From here we plunged down a break-neck shaly slope into the

Quotchkor ravine, where we baked some of our dwindling flour into flapjacks on flat slabs of stone. Two hours on through dense thickets at the bottom of a narrow V-shaped cleft to our great surprise we came upon Fatima, a loquacious Kirghiz woman with a little old silent husband; they probably belonged to some hamlet down the Raskam valley. She told us that our pursued were now only five days ahead of us, and this was confirmed by the distinctly fresher tracks. She even sold us a little barley-meal after some wheedling, and this helped the food supply. As we did not know where we were going, or how far the nearest cultivation was, or how many days' rations the enemy had, it was most welcome. Lower down the hills by which we were shut in seemed to get lower, and it seemed that we were only a few days' march from the plains of Turkistan. We learnt better afterwards.

Suddenly the trail ended. Casts forward were fruitless, both hillsides were unclimbable, so we went through the thick jungle in the valley bottom with fixed bayonets. We found nothing; suddenly the regular dafadar came upon the narrow mouth of a side ravine so filled with scrub that it had appeared to be unbroken hillside. Up this funnel the tracks led, and we followed, with all precautions against an ambuscade. We climbed and climbed up a small steep valley, and towards the upland was a small trickle of a spring where we had to bivouac for the sake of the exhausted animals. An early start into deepening snow took us up to a lung-racking pass of some 17,500 feet, called Furzanak, whence we continued the taking of bearings that we had commenced on the Tupa Dawan.

The descent led apparently nowhere into a maze of rock-bound ravines, but at noon we came to a tiny patch of grass. The enemy had spent the night here and reshod some of his ponies. A dead tame quail and his pathetic little straw cage told us the nationality of at least some of the party. Then a desperate climb of 4000 slippery feet found us at the summit of another snow-bound pass, grimly named Yettim Qozi ("the pass of the last lamb"). The struggling moon lit our way down to a bleak open upland, a "hanging valley" swept by a bitter wind. No water, no fuel, and no grass, so supperless to bed we went in holes scraped in the snow. This was the worst bivouac of the lot, and next day the wretched nags were too weak to be ridden an inch; however, they carried each man's blanket and our tiny stock of flour. The next pass called the Kandek was easy to ascend, but had a most breakneck descent to a tiny patch of grass near by a spring. We made our one and only meal here. This single meal had become a routine: we had neither time nor food for more. In the Raskam a fortunate shot had secured us a young burhel, which we had roasted whole over a brushwood fire and devoured, tearing it with our hands. This gave us a stomachful of meat, and the recollection of it lasted for several days. The food situation was now critical, and I had to watch the men to see that they did not give me more than my share.

Captain Blacker's Route from C
October.

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CHINESE PAMIR-YARKAND
Blacker.

THE UPPER VALLEY OF THE OXUS

RUSSIAN FORT OF PAMIRSKI (MURGHABI)

The next pass was called Pilipert, and we crossed it in the afternoon of the same day. It was one of the most difficult of over a hundred high passes that I have crossed. There was a snow cornice on the summit, a desperate matter for the ponies, of whom two died on the descent into the valley, where we found the cold remains of a fire and the round trace where a yurt had been, and this seemed to bring us back into the world of men.

Next morning we crossed the worst of the lot, the Payik pass with a cornice on the summit and ice-sheets on the slopes, so bad that unridden as they were two more ponies died on the way down to Kulan Aghil. The effects of the cold, exposure, and hunger began to show themselves on the men, and they suffered from old wounds picked up in France, Africa, and Persia. But not a word of complaint was there; the growing freshness of the trail was a constant source of joy to all ranks, and they were eager to push on. We had crossed six difficult passes in four days' climbing and descending about 54,000 feet. We had thus covered 16 map miles in over sixty hours' marching. Deasy describes how it took him ten days to cover 12 miles in this region.

We dropped into a valley full of vegetation, and the prospect was brighter. The map seemed less nebulous, and I knew that this Kulan Aghil valley had been traversed before by a European. Deasy calls this valley Kulan Urgi. A few miles down was a hamlet of five huts called Poenak, and we were once again amongst human beings, including at least one fair and apple-cheeked damsel with a kind heart for a soldier. We obtained some more ponies here, some barley and a sheep, and having, after many days, dined, fate could not harm us.

Now to our surprise the trail did not lead straight to Yarkand over the Sandal pass, but turned to the east up the valley of Chup. This is blank on the map, but actually holds some tiny homesteads every few miles and a little cultivation. We rounded up some more ponies, leaving our worn-out steeds behind, and at five in the evening reached a village high up in the valley, where we got some information from the Yuzbashi of the Kirghiz. Pushing on at dusk, by midnight we reached the summit of a desolate pass, a weirdly beautiful scene. To the south and east were the ice-bound peaks of the Karakoram and Kuenlun, virgin snow fields and glaciers as far as the eye could reach, the smallest details showing up clearly in the bright beams of the moon. Ahead of us to the north was a labyrinth of deep and gloomy gorges, equally unknown and untrodden, in black shadow. We were again in snow, but a steep path took us down through loess dust to a spring, forming the headwaters of the unmapped Shaksu.

At three in the morning we staggered in to a hamlet called Bulun, not on the map. The aborigines were astonished at seeing two batches of strangers in forty-eight hours, and they all talked at once at the tops of their voices. We were only two days behind the pursued, but here we got

off the trail, confused as it was by the villagers' yaks and goats. It was too late to turn back when we found the error. So we hoped to hit the tracks again later and pushed on. During all that day and night we made a nightmare march. We had to toil over four great passes, led up to by endless winding gorges. Of the first two I never found the names, as we met no human being, but the third and fourth are called Sakrigu and Akkas, and we crossed them in a soundless darkness. There was no track north from the Sakrigu; the animals floundered and struggled amidst huge boulders, and the scene was so ghostly that we could scarcely believe ourselves on this planet.

The cliff sides, a few yards apart, towered sheer up for thousands of feet, and at one turn a titanic excrescence of rock showed up like a perfectly formed ace of spades. This we took for a good omen, and when we debouched at midnight from the dreadful canyon to the desolate valley of the Kalisthan the men were still cheery, although there was no grass, fuel, or shelter. We pushed on over a fourth pass, and almost unconscious with fatigue came to the wretched deserted hamlet of Jibrail at four in the morning.

In this one march we had crossed four passes averaging about 14,000 feet, the last two in the dark. I estimate that we had covered something like 30,000 feet of ascent and descent in that time. Towards the latter part of the march we were too numbed to take much count of our surroundings, though this whole region, including the Chup, Shaksu, Pokhpu, and Kalisthan valleys, is almost unknown. Bogdanovich, however, made a journey into part of it in the nineties of the last century. Chup is a broad spacious valley, with plenty of vegetation. The lower part is rough and stony; the upper part is walled in by rounded turf-covered hills of loess, in which tracks are worn down into strange narrow runnels of 3 or 4 feet deep. Night marching here is a most creepy proceeding, since men and animals move silently in the deep dust, and the whole countryside is shrouded in an unearthly stillness as one toils up along the brink of some misty chasm.

On the north side, in the Bulun valley and in the next valley on, we found rougher and steeper hillsides covered with pine trees, which seem very rare in all the ranges east of the Tian Shan; at any rate, there are none to be seen in the Kara Kash valley further east by the Karakoram, nor yet in the valleys further west till one gets to Bostan Terek.

The Shaksu and Pokhpu country is wild in the extreme. Till we crossed the Kalisthan we were in a labyrinth of immensely deep canyons, with vertical sides, barren of vegetation except a little scrubby grass that covered the tops of the passes.

In Pokhpu there are one or two huts and tiny patches of barley tilled by people called Taghliks. The whole population of the area, however, did not seem to be more than half a dozen.

On the Akkas pass we found loess again.

At Jibrail there was no water, so we slept for a very few hours in a hut and then pushed on. Just as we were riding off down the valley a very old pink-faced Kirghiz, with a couple of horsemen, evidently a man of some consequence, and from his green turban apparently a Haji, came round the corner, much surprised to meet an armed party, and somewhat overwhelmed by the uncompromising aspect of the ragged and hirsute men. His attempt to cross-question us was anticipated by our demands for an explanation of his presence and doings, and eventually we took him along with us. He became most friendly and helpful, in time.

Since coming down from the Kara Tash during the night we had had no water, and we were very glad to find a kind woman in a hut in the Ak Masjid valley who gave us some out of a gourd about midday. We were now in a broad open sandy valley, bounded by low hills, which took us to Kök Yar (often called Kugiar on maps). The country was very dry, and this was the only drink we got till we reached that village. Here we really got back to the world and truly realized the meaning of the word "Vitamine," as only men can who have been for weeks on nothing but meal and meat, with precious little of the latter. We filled up on corn-cobs and melons and felt years younger.

Only five hours could be spared for eating and sleeping, since we realized that the pursued were probably in the Tiznaf valley, the next one parallel to ours to the west. I sent into Karghalik, making certain unostentatious arrangements there, and at midnight, mounting our horses again, we carried out a compass march over the low range of hills that separated the two valleys. Careful steering aided by luck brought us straight down into Arpat Bulun village, after an exhausting march through the fine deep sand which covers all these foothills. We found no clue in this village, and so pushed on straight across the desert to Khan Langar, which we reached about midday next day. Our track took us clear of the foothills, and now and again we came to little patches amidst the sand irrigated artificially by water led down from the hills. This march was extremely trying, since we had had no proper sleep since we left Poenak four days before, and we had a continuous fight to keep awake whilst marching.

Khan Langar is a big village on one of the countless branches that the Yarkand river is split up into. It is on the edge of the big fertile oasis. We pushed on to Posgam, reaching it at about three in the morning, after a lot of trouble in the dark amongst the irrigation ditches and canals.

Next morning found us in the Chini Bagh a mile outside Yarkand city. One of the men was sent inside with orders to bring out the Aksakal (consular trade agent) without attracting attention, and in this way we got on to the trail of our pursued again. Before the teeming population was properly awake we cantered through the narrow alleys, and suddenly the inhabitants of the Badakshan Sarai received the surprise

of their lives when nearly a score of distinctly tough-looking Punjabis, Pathans, Hazaras, and Kanjutis, bursting in on them with their bayonets fixed, made them put up their hands. The sorting out of the fifteen that we wanted and the securing of their Austrian rifles and bayonets took some little time and care, but we got all but two, who with some more rifles were arrested by the Chinese later on. To our great disappointment there was no German with them.

The next two days were spent in ceremonial interchanges of visits with the Chinese Mandarin.

Having captured our prisoners, our next object was to rejoin our battalions in Palestine and Mesopotamia as quickly as possible. We covered the 155 miles to Kashgar in two and a half days, and as the season was late much of this was done by night.

We spent a few days in Kashgar, handing over our prisoners to the Chinese authorities and collecting fresh ponies and rations for the journey to India. The month was November, and the crossing of the Pamirs and all the great ranges to the south of us did not seem a very pleasant prospect, especially as we had no tents and no more kit than we stood up in. Every day made the outlook worse, so we pushed off to Tashmalik on November 5, Guy Fawkes' day, with rumours of Boche peace talk in our ears. We reached the Chinese fort at Bulunkul on the snowy evening of the third day, and found ourselves in the grip of a Pamir winter. At Payik, on the sixth day out, we found the broad swift Karachukor river frozen 2 to 3 feet thick, and many Kirghiz lying dead from influenza. This was at an altitude of 14,000 feet, and no Kirghiz would have been there at all in that season had not Bolshevik depredations driven them from the lower valleys of the Alai.

We were very glad to get over the Mintaka, and the night's bivouac at Mirkushi, in an open sheep pen, at 13,000 feet seemed almost stuffy after the howling blast of the Pamir. I had managed to provide the detachment with sheepskin caps at Kashgar, and to wrap the stirrups in felt, which undoubtedly helped to ensure our immunity from frostbite; all the same the cold was something never to be forgotten. My men were old and tough campaigners, some of whom had been bandits in civil life, and they needed no dry-nursing in the matter of their fingers, toes, and ears. Every man of the party but two contracted influenza, but nevertheless kept up with the patrol, which averaged over 40 miles a day; in fact, it was essential to keep moving if we hoped to reach lower levels without catastrophe.

At Gircha we got in touch again with our good Hunza friends and slept on beds under roofs, wonderful and almost forgotten luxuries. At Gulmit, falling in with His Highness the Mir, we played the very intensive polo of the country and watched dances. Two days more found us in Gilgit, on the twelfth day out from Kashgar, which I think was pretty good going for winter. We had to leave our ponies here, and pushed on

TYPICAL HILL COUNTRY IN SOUTH-EAST CASPIAN REGION

GAU KOTAL IN KARA DAGH, NEAR KHAUR VILLAGE, BETWEEN MESHED AND TEJEND, LOOKING NORTH-WEST

PASS BETWEEN BAJGIRAN AND JIRISTAN IN THE KURD COUNTRY OF NORTHERN KHURASAN

DURBADAM VILLAGE NEAR KUCHAN, NORTHERN KHURASAN

on foot over the Burzil and Tragbal passes into Kashmir and all the luxuries of civilization.

Part II. To Trans-Caspia.

The men had only had a few days' leave in their homes when the second phase of our wanderings opened, and we were sent up through eastern Persia to the Merv front. Railhead was then at Mirjawa, arid and sunbaked even in December, and we marched up across the dreadful dreary wastes of Persia for some 800 miles. After plodding along for about 300 of these we got into higher ground and more northerly latitudes and found ourselves in winter once again. In fact, for a good many days we marched through deep snow, having to our joy exchanged our camels for a wagon at Birjand. Snow fell frequently, but it was child's play compared to the Pamirs, even if some of the quaint black hospital and commissariat followers from Madras, Bombay, and Hindustan found it a little too bracing.

We arrived at Meshed in January, and after a few days there pushed on through the snowbound Kara Dagh into the Trans-Caspian province of Turkistan, the home of the Turkman, till now a tribe of almost legendary fame.

We reached Merv by train and found our force headquarters installed in the late Tsar's palace at Bairam Ali, an eastern suburb of the town. Merv just before the war had been quite a flourishing city of western American appearance and seemingly of mushroom growth. Really, of course, it is one of the oldest cities in the world. Many great ruins cover the oasis; one former Merv was built by Alexander, and half a dozen others by great conquerors: Greek, Mongol, Arab, Tatar, and Persian.

Our force was a curious and motley assemblage. The Commander-in-chief was General Sir Oraz Sardar, K.C.M.G., a Tekke Turkman, and the son of their chieftain Tagma Sardar who was killed in 1884 defending Geok Tapa against Skobelef. Our general, then a youth, was sent to the Imperial Corps of Pages at Petrograd, and finally became a Major-General in the Imperial Army. Under him, the British portion of the force was commanded by Brigadier-General Beatty, and comprised one section of two 18-pounder guns of No. 44 Battery R.F.A., two or three squadrons of the 28th Light Cavalry, and the 1st Battalion of the 19th Punjab Infantry. Besides this there were two or three batteries of Russian guns and howitzers, manned by Menshevik officers and N.C.O.'s; a squadron of Russian Cavalry, similarly composed, and a couple of regiments of Turkman horse and a battalion of foot. The Bolsheviks, some seven thousand strong, had been very roughly handled by this little force, which had only just grown to its present size. At the actions of Artik, Kaakha, and Dushakh the Red Army, which included some five thousand trained regular Magyar and Austrian soldiers, had been routed by less than three companies of the Punjabis, who with a squadron or two

of cavalry bore the brunt of the fighting. Even the guns did not arrive till later.

These little battles, away in the remote deserts of Central Asia, had no little effect on the duration of the great war itself. They were fought, it must be remembered, when General Dunsterville's two British battalions had been forced out of Baku, and hence nothing but these few hundred Punjabi bayonets stood up against the German plan of uniting a German Corps from the Caucasus with probable Afghan armies, with thirty or forty Austrian battalions from Turkistan, with the Red Army, and with Enver's hoped-for insanitary hordes. Nor was this end reached without severe fighting: at Dushakh alone Major Knollys' tiny force lost 50 per cent. of its effectives, including every officer. Nevertheless the Bolsheviks were chased 300 miles in four months.

These three battles were fought whilst we were still in Tashkent, and in almost daily intercourse with the Soviet and their War Ministry. This fact of being on the wrong side of our own front was of great interest to us, and the panic that the commissars got into at the news of each fresh defeat caused us vast if carefully suppressed merriment. Before long the very mention of the word "sipahi" made them shiver with apprehension. In February another action took place; the Red Army sustained a fourth reverse, but as, for reasons of high policy, they were not to be pursued to the Oxus, stationary warfare ensued through February and March. During this breathing space some of the detachment were occupied in getting into touch with our Turkman allies and compiling information about them, largely ethnological. Meanwhile the Turkman regiments were in an unsatisfactory state, lacking discipline and cohesion almost entirely and technical training to a very great extent. So the balance of my N.C.O.'s were put on to instruct them, with most encouraging results. Karaz Sardar's regiment was perhaps the best of the three. He was a very fine old man and very typical of his race. He and some of his sons were killed later in a Bolshevik ambush near the Persian border.

These Turkman are of course the same that one reads of in Morier's "Haji Baba of Ispahan" and celebrated for their wonderful raids into Persia. O'Donovan, who was with them in 1885, gives an excellent picture of their life in his 'Merv Oasis.' They are a hospitable, frank, upstanding and engaging race, and were very friendly to us, especially to the Punjabis, with whom they have much in common. They are not unwarlike, but one doubts whether they could ever stand against Afghans, Pathans, or Punjabis, however well led or trained.

The fact that they are nomads is much against their ever becoming real soldiers, since they have not that attachment to the soil that agricultural peoples have, which leads them to get killed in defence of it. All the same, whatever their shortcomings we came to like them a great deal.

The Russians had done much to develop the country in the few years before the war. At Bairam Ali, for instance, a canal had been brought

down from the barrage at Hindu Kush, whose water came from the hills near Kushkinski Post, the fortress over against Herat. This canal irrigated many square miles just east of Merv, and these were considered a private estate of the Tsar Nikolas; hence his palace there. Many of the plots had been given to Hazaras, descendants of Jenghiz Khan's troops. Some of these Hazaras, who were of course Russian subjects and tenants of the Tsar, were serving in the Guides Cavalry, following their fathers and grandfathers, and four of them were now in my detachment, so that the fortunes of war had brought them many score of marches back to their own homes. At the end of March we were relieved by a large force of General Denikin's Volunteer Army, and we marched back into Khurasan, charged with the defence of that province against the Bolsheviks.

One of our commander's first steps was to visit the Emperor Nadir's marvellous natural rock fortress. I accompanied him, with a small patrol of Guides. The Khan, Fatteh-ul-Mulk, a Turkish gentleman, entertained us most hospitably, and we spent a full week inside this marvellous place, where millions of pounds' worth of Nadir's treasure is reputed to be buried. We did not find it. The Kelat is something over 12 miles long, with a maximun breadth of about 5, and girded all round with vertical and inaccessible cliffs. Only three or four gorges allow passage to camels, and there are some goat tracks affording entrance besides. The district with some outlying parishes is held as a Karaul or fief from the Shah of Persia by the Khan, who is the chieftain of a tribe of Turks settled in this place by Shah Abbas, I believe. They live in half a dozen villages inside, growing crops and fruit and keeping numbers of cattle and sheep.

The weather during our stay in the Kelat was very wet; in fact, both my journeys through this part of the Kara Dagh were in surroundings quite unlike the shining East. Slippery clayey mud underfoot, leaden skies overhead, and a constant soaking drizzle in the valleys gave way to snow flurries on the uplands. It was certainly homelike, rather too homelike, but it accentuated our appreciation of the warm billets that we generally found, and of the steaming tea and cheery samovar that my young orderly always managed to conjure up.

The first day was fine, and our climb to Khist hill, one of the peaks of the northern range, was amply repaid. Four thousand feet almost directly below us little puffs of smoke showed where Bolshevik and Loyalist were locked, with their armoured trains, in a not very deadly conflict. We could scarcely have had a better view of the fight from an aeroplane. Northwards from there the inconceivably immense plains of Mid-Asia stretched away to the Arctic Ocean. To the west we could discern Artik, and to the east Dushakh, both on the railway, and the scenes of British battles. Before the rain came we secured a few photographs and made a hasty sketch of the interior.

The sudden outbreak of the Afghan war brought us back swiftly to Meshed, which was to some extent threatened by the Herat Division of the Afghan Army. Several of the detachment under my command were at once employed on the Afghan frontier, and in the intervals of their other duties managed to carry out some topographical work, not to mention securing some excellent little horses from the King's Own Regiment of the enemy's cavalry. Old frontier soldiers will appreciate how early one must rise in the morning to obtain anything from an Afghan regiment unbeknownst.

During June we were able to visit Nishapur, the home of Omar Khayyam, and to map some of the route. Besides this we managed to put in a good deal of topographical work during the summer, mainly with improvised appliances. But in August we had the good fortune to be able to map, mainly with a plane-table, some 700 square miles of quite unexplored and not uninteresting country, which took about twelve days. The party, which was very small, comprising only six officers, N.C.O.'s, and men, furnishing its own escort, moved north from Meshed, crossing into the beautiful well-watered Khaur valley by the aptly named Sanduq Shikan pass. Next day we crossed the main precipitous range of the Kara Dagh by the Gau Kotal, dropping down breakneck gorges into the tree-embowered village of Zao.

Then cool upland country gave way to arid sun-baked downs which in springtime afford grazing to the flocks of Kurd, Hazara, and Turkman. We touched human habitations at the wretched little frontier village of Chacha, meeting a few Tekke Turkman, who favoured us with their unexpurgated opinion of the Bolsheviks. For the next three days we marched up and down over countless small barren ridges covered with a curious alluvial blue clay. The whole country shelved gently down north-eastwards from the vertical scarps of the Kara Dagh range towards the plains of Merv and Tejend. Strangely enough though, at the very foot of the gentle alluvial slopes a vertical cliff wall suddenly springs up to over 500 feet in height and many score miles in length. In fact, this wonderful barrier stretches along the Russo-Persian frontier line from Sarakhs right round to Gifan in the Kurd country. Kelat-i-Nadiri is itself what a sapper would call a "horn-work" to this rampart. Here, as in most stretches, the vertical cliffs face inwards towards Persia, the outer slopes being gentle and quite rideable. Not only is this cliff line unbroken except where occasional streams force their way through narrow gorges, but it is quite impassable for anything but trained cragsmen with ropes. Moreover, it is in most places a double line, the main scarps of the mountains being supplemented by an outer wall of much less height but greater impenetrability.

No doubt the unwarlike if convivial Persian owes his continued existence in no little degree to this natural bulwark, which has kept the Turkman and the Mongol and even the Russian from getting at him as effectually as they would like.

Crossing the caravan track joining Meshed to Sarakhs and Merv we came to two interesting landmarks. The first is a little artificial lake called Köl-bibi, "the lake of the lady." The lady is the same that built Pul-i-khatun, the daughter-in-law of Tamerlane. The lake is formed by a dam across the mouth of a little glen, and fed by a spring hidden among rushes at its eastern corner. The lake water is salt, doubtless as a result of the desiccation of this part of Asia, but the spring is fresh and was very welcome, since we had drunk nothing but brackish water for several days and scanty at that. A few miles on, hidden in the folds of the undulating but desolate countryside, is the ruin of a fine fort called Robat-i-Sharaf. Its walls are of red brick of a surpassingly good quality, its gateways adorned with antique blue tiles, and its corner towers are of an unusual shape, semicircular with little clean-cut salients joining them to the curtain-wall on either hand. A dry well and reservoir 100 yards away showed whence water had been obtained in the spacious days of Tamerlane and his dynasty, and certainly this barrier-fort must have been a strong and shapely pile in its prime.

We struck back to the south by the Mazduran pass over the Kara Dagh range into the Kashaf Rud valley, and three days' more marching up this poisonous affluent of the Styx found us back in Meshed. The results of a week's drinking of a nasty solution of Epsom salts and mud locally known as water demanded a few days' recuperation in that city.

During this journey, and subsequently, I had the great advantage of the presence of Subadar Afraz Gul, a young survey officer who has worked for years under Sir Aurel Stein in Central Asia. There are few countries therein that he has not visited, and his topographical skill and knowledge are of a very high order indeed. In fact, for rapid plane-table work in an unknown countryside, I have never seen his equal. A sequel to this piece of topography was the discovery that the latitude of the Russian maps about Sarakhs is incorrect to the extent of 3 miles. This error diminishes towards the Caspian, being some two-thirds of a mile in the longitude of Ashkabad (Poltaratsk).

But we were not left idle for very long. In August, several hundreds of the Armenian rabble in their ranks having turned traitor, the Volunteer Army lost Ashkabad to the Reds, who threatened to invade Persia, or at least, by means of propaganda, to incite the scum of the slums to give trouble. The Persian frontier had to be watched, not only to give due warning to our commander of a regular attack, but also to keep out spies and propagandists. Accordingly, the detachment was moved to a little frontier village named Bajgiran to perform the advanced duties, whilst a company of regular infantry provided the main military force. The detachment had some 160 miles of frontier to watch, and this section was flanked on the right by the territory and levies of the Khan of Darragez, and on the left by the Sardar of Bujnurd and his Kurds.

The work soon split into two sections, the patrolling, or combatant,

and the topographical. The former was helped out by fifty Kurdish levies who were attached, thereby expanding the party to an appreciable fighting unit, whilst the trained surveyor Subadar Afraz Gul, helped by two more jemadars and a couple of N.C.O.'s with some hastily imparted topographical training, devoted themselves to the map work.* During 1919 and early 1920, in spite of many interruptions from blizzards, deep snow, constant rain, actual fighting, and minor disturbances, they dealt with nearly 14,000 square miles of country, of which an appreciable proportion was up till then not only unsurveyed but unexplored. The details of this work would fill an article by themselves, but it may be of interest to show how such a large area was covered by an average of only two to three topographers in the time.

The essence of the matter was mobility. The topographers, assistants, cooks, and escort were all mounted and armed. As the country was unsettled, each party had to include six rifles, and four or five of these were usually Kurdish levies in our pay, armed and clothed by us. They were most useful as interpreters, messengers, and especially as foragers for the party, which of course lived on the country, except for tea and sugar. The surveyor's assistant who carried the plane-table, and his cook, were fortunately both Punjabis, so could ride and carry carbines. Hence there were no unarmed mouths to be provided for. The *modus operandi* was this. The operator set up his table and made his first fixings from two or three peaks near Meshed which had been fixed by the Afghan boundary commission in 1885. The regular survey section that was employed on the line of communications very kindly went out of their way to fix a few more peaks in the Hazar Masjid range for us. From these the plane-table could be set up with a very fair accuracy, and well enough to fix peaks many miles further afield as points to hang more plane-tabling on.

The plane-table itself was not used for the whole area, of which nearly all was covered by work on cavalry sketching-boards; where there were Russian maps already of an area, the sketching-board was the only tool used for filling in detail. In short we used the plane-table where the regular survey section uses the theodolite, and we used the cavalry board where they would use the plane-table. The accuracy thus obtained was amply sufficient for needs of the fighting troops, since there was nothing remotely approaching static warfare and the consequent squaring of maps for the artillery. In this way most of the valleys were traversed by a mounted N.C.O. with a "cavalry board," at the rate of some five miles an hour. The result of this work was then adjusted by means of the pantagraph to the net made by the plane-table, sometimes with the aid of a pocket sextant. Important heights were obtained clinometrically on the plane-table, but less important ones by aneroid. We were careful, however, not to rely upon the latter instrument except for relative differences.

* As an instance of the natural aptitude of the Pathan for topography, one young Yasafzai was able to make a useful plane-table sketch after ten days' instruction.

Each topographer carried a hypsometer, which he boiled at his night's bivouac. Calculation in correcting boiling-points for air temperature was avoided by employing a graph drawn on squared paper, whereon the ordinates are altitudes, the abscissæ are degrees and tenths, and whereon several lines are provided, of different colours, at convenient differences of air temperature. The hypsometer height thus corrected was plotted on squared paper again, using the back of Army Form C 2121. On this the ordinates are again altitudes and the abscissæ times, *i.e.* days and hours. The topographer not only plotted his hypsometric heights on this, but also his barometric readings, being careful to read and plot his aneroid whenever he boiled his hypsometer. The resulting curve made it extremely easy to correct the aneroid heights by inspection and a pair of dividers. A little work was done by traversing in narrow valleys on the subtense method, using a pocket sextant and a lance. This instrument was of use in places to replace a theodolite, and is certainly excellent for rapid work where great portability is important.

To reproduce the maps required for the immediate use of the troops we used ferrotype paper in a home-made printing frame. The results were not as satisfactory as we should have liked, since the paper is too fragile for much use in the field, especially as we had to employ the kind giving chocolate lines on a white ground, to admit of roads, etc., being coloured in by hand. This was the best we could do, and we were fortunate enough to be able to prepare and print maps of the area in which fighting soon after occurred in time for issue to troop and company commanders concerned.

Meanwhile the patrolling portion of the detachment, even expanded by our fifty Kurds, had its hands full. Very soon after the capture of Ashkabad, now renamed Poltaratsk, the Bolshevik "Politicheski Oddiel" commenced to send propagandists and agents across the frontier to work amongst the Persian and Caucasian bazaar loafers. Our patrols caught several of these, and before long the Red administration could get no one to take on the job. An interesting poster that we secured, specially designed for Indian consumption, depicted three naked emaciated Dravidians harnessed into a plough, at the tail of which stood a typical John Bull with projecting teeth and ginger whiskers, brandishing an automatic pistol in one hand and a nagaïka in the other.

The winter was characterized by incessant patrolling, which helped us to correct the maps to some extent, and by an influx of refugees and deserters from the Red Army. We entertained a wonderful medley, the bulk being Magyars late of the Austrian Army. Besides many sorts of soldiers—Czech, Austrian, Rumanian, Serb, Italian, Cossack, Lesghian, Turkman, Kurd, Tatar, Armenian, Georgian, Persian, Pole, and Russian—we had many civilian refugees, including women and children. Often in the depths of winter these wretched people arrived, starving and frost-bitten, led by smugglers over mountain goat-tracks. Perhaps our most

remarkable guests were seven Algerian soldiers, still in their "bleu horizon," who had been captured by the Reds at Odessa in 1917, and had made their way *viâ* Moscow to Tashkent and Ashkabad. Wonderful to relate, the first patrol to find them included two Pathans who had served in the Lahore division when it was brought up to Ypres in April 1915 to counter-attack after the Germans had broken the line with gas. There they had lain with a North African division wherein four of our escapers were serving.

During the spring Bolshevik plans began to crystallize. Emboldened by the success of their *protégé* Kuchik Khan, on the Caspian coast, they endeavoured to create a second Kuchik in Khurasan. They selected a minor Kurdish chief named Khuda Verdi Sardar, who had, before the arrival in Khurasan of sepoy and cossack, made a comfortable livelihood by brigandage. He had even collected seventeen wives, some not uncomely. The slump in the bandit business had made him discontented and a ready tool for Comrade Paskutski's hand. Accordingly, the other side despatched several convoys of machine guns, rifles, and ammunition to him. We managed to keep touch with all these, but since it was an internal Persian matter could not interfere, at any rate at first. The Persian was quite unequal to competing with the situation, and matters became critical, several hundred Kurds, with good ponies and magazine rifles, joining the standard of revolt.

Open rebellion followed, complicated very much as far as we were concerned by the massing of several thousand Red troops,* with guns and aircraft, 30 miles to our front on the metalled road forming the main line of advance into Persia. This tied our company of infantry down to the outpost line to watch them, whilst the alarums and excursions went on in the Kurd valleys to the west of our headquarters.

Our three standing patrols in this direction managed, after some adventures, to concentrate at a village called Jiristan, 22 miles to the west, and to which a bridle path ran up a rough narrow valley with cliffs on either hand, over a pass of 7400 feet. Jiristan was at once reinforced by two troops of our Kurdish levies and by a company of Persian infantry. Hardly had they arrived than the surrounding hilltops were sangared by the enemy and the place invested. Desultory fighting followed between our piquets and the advanced elements of Khuda Verdi's forces, and one of the Persian infantrymen was slightly wounded, whereupon the whole company were seized with panic and absconded in haste. Meanwhile our own Kurds, kept to it by their Regular instructors, held their ground.

Fortunately, another company of Regular infantry turned up. This eased the situation with regard to the Bolsheviks, and we were able to send out a small column that evening. The commander was an Afridi

* The legend inscribed over the door of the Bolshevik First Army headquarters in Ashkabad ran, "Our mission is to set the East in flames."

jemadar of the Guides, with a havildar as his staff officer. Two sections of Kurdish levies were his cavalry; he had a Lewis gun with Khattak gunners, a section of bombers, Regulars, some being Pathans and some Hazaras, and the infantry of the column were a platoon of Hazara foot levies.

This column pushed out at ten minutes' notice, and fought and marched for forty hours on end. The back of the revolt was broken, Jiristan relieved, Khuda Verdi became a fugitive, the Bolshevik 1st Army command turned him down and withdrew their own troops from the Persian border.

So with a neat exhibition of minor tactics on the part of Jemadar Amal Baz the curtain came down on our three years of toil in Central Asia, and we marched back through 700 miles of hills and deserts to our railhead on the frontiers of Baluchistan.

Before the paper, the PRESIDENT said: Captain Blacker had the advantage of being employed during the war in regions partially or quite unknown. But he had the disadvantage of having to travel so rapidly that he had little opportunity for making and recording observations of geographical interest. We must therefore make allowances for him in listening to the lecture which I now ask him to give us.

Captain Blacker then read the paper printed above, and a discussion followed.

Brig.-General Sir PERCY SYKES: I think Captain Blacker must have made a record for distance with his little party, and I should like him to tell us how many thousand miles he has travelled. I imagine it must be something like 10,000 miles, which must surely constitute a record for a patrol, even in the Great War. I noticed that the Afghans he pursued in Chinese Turkistan had the bad taste to go over the most uncomfortable part of the country, and as he was going extremely light, it is marvellous that he got through all right. There is nothing more unpleasant than sleeping without enough bedding, and nothing more dangerous to health. The Sarikol Valley is very interesting. The inhabitants of it talk Persian and are the last people to do so eastwards, and they are, curiously enough, followers of his Highness the Aga Khan. Their leaders go every two or three years over those tremendous passes and make their report to his Highness at Bombay, and it gave me rather an insight into how far the influence of the British Empire stretches. Here was this most God-forsaken place, with winter for ten months of the year, looking steadily to India. When my sister and I went to lunch with the wife of the Russian commandant at Sarikol, she showed us her garden, and there were merely a few little cabbages coming up! It was an extraordinarily cold climate through which Captain Blacker and his party had to travel. It was August when we were there, and I remember on one occasion I woke up to find a couple of feet of snow on the ground. The Pamirs are termed the "Roof of the World," and that is what it means.

I was also deeply interested in hearing about north-east Persia, and I most warmly congratulate Captain Blacker on having added so much to the survey of the country. I used to go about with a solitary surveyor, and managed to do a good deal, but I never had proper resources in the way of men, plane-tables, and theodolites. I think we can see that the war has not been entirely

destructive in Persia. Here is an instance of it, both in the shape of roads, to which the lecturer referred, and sound geographical information.

Colonel Sir CHARLES YATE: Our lecturer this evening has taken me back to many old scenes and reminiscences, which, I can assure you, has been a great enjoyment to me. He recalled various scenes in Merv. I recollect visiting Merv very well, and I thoroughly enjoyed seeing his pictures of all the various places round there. I was astonished to hear that Hazaras were amongst the cultivators there. They are a Shiah tribe who live in the heart of Afghanistan, and when I was at Meshed we had a very large influx of them there from Afghanistan. They were known there by the name of Barbaris. When I was Chief Commissioner at Quetta, Sir Claud Jacob, now Chief of the Staff in India, then commanding the Zhob Levy Corps, was able to raise a fine regiment of these Hazaras. A splendid regiment they made, and I believe they did excellent service throughout the war and proved themselves to be capital pioneers and soldiers. I was very glad to hear that some of these Hazaras in the Guides Cavalry had done such really good service with Captain Blacker in his long journey to Merv. It was an eye-opener to me to hear how Hazaras were spreading all round the country from their original home in the heart of Afghanistan, as in my day it was difficult for them to get out of Afghanistan. Captain Blacker also referred to the guns that were taken from the Afghans at the battle of Panjdeh. That brings back long memories of the time when I was at that battle. I was the British officer there at the time, and I remember I had only nine men with me when the Russian troops marched down. The lecturer told us of Kalat-i-Nadiri. I remember visiting the place. It is one of the most curious natural forts you can have—a large semicircular valley rising gradually to the edges with precipitous cliffs all round it. Who is the man who will find out the treasure that is supposed to be buried there? The Persians in my day were very jealous of admitting strangers into the place, but I was able to get there and so was Captain Blacker, though we had no chance of finding that hidden treasure.

The PRESIDENT: In spite of the disadvantages under which he laboured, Captain Blacker has succeeded in bringing us back some valuable information. Most interesting, perhaps, is that part of his lecture which dealt with that very heart of Asia where not only three empires meet but also three great mountain systems meet—where the Hindu Kush and the Pamir Mountains meet the Kuen Lun. Here the lecturer found a succession of terrific gorges and mountain ridges. To set these down with accuracy, prolonged and careful survey would be required, and for that Captain Blacker obviously had no time. But his experiences are valuable as drawing attention to the topographical interest of this region. He spoke also of the loess deposit on the mountains. The atmosphere in Chinese Turkistan is nearly always dull. This is due to its being surcharged with dust from the Gobi desert and the Takla Makan. And this dust is precipitated on to the mountains—the coating being heavier on the outer ridges and lighter the further away from the desert the ridge is. You will, I know, like me to thank Captain Blacker for his graphic description of adventures in widely separated parts, and to congratulate him upon having come safely through them.

ON THE ORIGIN OF MOUNTAIN RANGES

Colonel Sir Sidney Burrard, K.C.S.I., F.R.S.

Read at the Afternoon Meeting of the Society, 9 May 1921.

THE origin of mountains is a wide topic; its study requires the co-operation of different students of science, geologists and mathematicians, seismologists and engineers, geographers, physicists and chemists. In a brief paper I can only attempt to refer to a few salient points that require discussion and help.

Mountains are the elevated portions of the Earth's crust, and in these discussions it is necessary to consider at the outset the structure of the Earth itself. The old theory of a liquid interior and of a crust supported by flotation has been abandoned. Modern astronomical, seismological, and mathematical investigations have all combined to show that the Earth is solid throughout and that its crust possesses the rigidity of steel; the evidence in favour of solidity is now very great, and upon this fundamental fact we ought constantly to insist.

When we come to think out how mountains have arisen, the primary question at issue appears to be this—Have they been elevated by horizontal compression of the surface or by vertical uplift from below?

One of the most conspicuous features on the flanks of the larger ranges is the compression which strata have undergone: strata which were originally horizontal have been squeezed into folds. It was the compressions of strata that gave rise to the well-known Contraction Theory.

According to this theory the Earth's crust was wrinkled into mountains by horizontal compression; the Earth's interior was supposed to be cooling and contracting, and the outer crust was thus becoming too large for the shrinking core and was wrinkling into folds. The chief objection to this theory has been that the contraction by cooling is inadequate to account for the amount of elevation which mountains have undergone.* Osmond Fisher showed that the radial shrinkage of the Earth due to loss of heat had not been sufficient to produce mountains of even 100 feet in height.

Other objections have been raised: it has been pointed out that the principal mountain ranges were elevated in one geological age and that they are confined to certain narrow zones. If a core is slowly shrinking away from its outer shell, the latter will wrinkle in all ages and in all parts of its surface. To ascribe the rock-folds that have been concentrated in Central Asia to a general shrinkage of the Earth's core is tantamount to assuming that the crust is loose from its core.

If moreover ranges were surface folds we should expect to see the horizontal strata, in which the rocks were originally laid down, lifted up

* Osmond Fisher, "Physics of the Earth's Crust." Dutton, *Phil. Soc. Washington Bull.*, vol. 2, 1889.

and arched over the ranges. The Himalaya ranges are composed of granite, which has been uplifted from below, and although the stratified rocks on the south side of the granite have been compressed, the crumpling which they have suffered seems to be local.* There do not seem to exist any relics of great arches of strata, such as might be expected, if the ranges were folds of the Earth's crust.

In face of these objections it is difficult to be satisfied with the theory that mountains have arisen from horizontal compression. And we have to face the question—What is the force that has raised mountains? The force of gravity acts vertically downwards; what is the force that is able to lift rock-masses to great heights in opposition to gravity? This force is to be sought for in the physical and chemical changes that rocks undergo. The rocks composing the crust are heterogeneous mixtures, and they are continually undergoing changes. Sir Hubert Hayden told me that the gneiss of the Neilgherri mountains varies in density from 2·67 to 3·03, that is 14 per cent., and that the rock of the Hazaribagh plateau varies from 2·5 to 3·1, or 24 per cent. Dr. Fermor (*Records Geolog. Surv. of India*, vols. 33 and 34) has closely studied the lavas of Western India; he estimates the density of eclogite at 3·3: under a decrease of pressure the eclogite will pass into gabbro of density 3·05 and into basalt of density 2·95. The increase of volume involved in the passage of eclogite into gabbro is 8·2 per cent. An elevation of 2000 feet will be caused by the passage of a column of eclogite, 25,000 feet deep, into gabbro.

As conditions of pressure and temperature vary, rocks undergo changes of volume and density. It is to these changes that we have to attribute the elevations at the Earth's surface. The highest summits are generally composed of granite, and the granite masses are believed to have risen out of the crust.†

The range of mountains known as the Western Ghats skirts the west coast of India, and it traverses two different portions of the crust. South of latitude 16° it crosses an area of gneissic rock, and is itself composed of gneiss, its peaks rising to 6000 feet: north of lat. 16° it crosses an area of volcanic rock, and here the mountains are built up of numerous horizontal strata. It has been thought that the horizontal strata of lava may have been originally laid down at their present high altitudes; but this line of elevation continues beyond the volcanic area into the area of the gneiss; it is evident that there has been a line of upheaval across both areas. The horizontality of the strata and the absence of compression on the volcanic section show that the upheaval has been vertical and that the range has been elevated to 5000 feet without any disturbance or tilt.‡

* Hayden's sections, plate xxxviii. part iv., "Sketch of the Geography and Geology of the Himalayas." Also sections by Middlemiss, *Mem. Geol. Survey of India*, xxiv.

† "Interior of the Earth," by Chamberlin, *Proc. Americ. Phil. Soc.*, Sept. 1915.

‡ The isolated peak of Guru Sikkar (Mount Abu) standing up out of the desert, 5650 feet high, may be a northern outburst of the Western Ghat range: compare deflections at Deesa and Chaniana with Colaba, *Phil. Trans. Roy. Soc.*, A, vol. 205, p. 310.

The largest protuberance at the Earth's surface is the plateau of Tibet. In 1851 Richard Strachey found the bones of elephant and rhinoceros at a height of 15,000 feet in Tibet, in deposits of silt which are as horizontal now as when they were first laid down (*Journal Geolog. Soc.*, 7, 306).

At its present altitude Tibet is almost arctic in its climate, whilst the elephant and rhinoceros are tropical animals. Strachey explained the presence of these animals in Tibet by assuming that the horizontal strata had been elevated from sea-level to their present height since the time when the animals had lived; he suggested that these strata had been raised vertically without any tilt, compression, or disturbance.

It may be asked if the evidence in favour of vertical uplift be so strong, why has this solution not been accepted? The answer is that vertical uplift does not explain the horizontal compression of strata. In the Western Ghats there is no horizontal compression, but the flanks of the Himalayas and of the Alps furnish evidence of compression. Some writers have tried to divide mountains into two classes, the vertical and the horizontal; but there is no justification for such a step; in one Himalayan area the bones of elephants have been raised vertically, and in another Himalayan area there are signs of horizontal compression.

In this difficulty let me turn to geodesy to consider the evidence it furnishes. Its principal contribution has been the discovery of Isostasy, which has taught us lessons concerning the structure of the crust, and concerning the behaviour of rock masses under varying conditions of pressure. According to the theory of Isostasy, all elevations are compensated by deficiencies of density underneath them, and all oceanic depressions are compensated by excesses of density underneath.

In the diagram (Fig. 1) I have drawn a section of the crust from mountains to sea, and the vertical lines descending from the surface to a depth of 70 miles show the vertical columns of Isostasy. In each of these columns there is the same amount of matter per unit of area: the high columns have no more mass per unit than the low. The high columns are of low density, and the low columns are of high density.

The horizontal lines show how the isostatic crust is divided by geologists into three shells—the sedimentary, the granite, and the basaltic. The basaltic shell is the principal seat of isostatic compensation.

In 1860 Pratt contended that mountains had risen up out of the crust by vertical expansion, and that their extra mass above sea-level was compensated, because its own rise by expansion had created the deficiency below. This explanation is no longer considered complete. Mountains that were elevated many ages ago and that have been suffering losses of rock from the unceasing destruction wrought by weather are found in this our own time to be accurately compensated by deficiencies of matter below. So we have to explain how the compensation of the mountain is being accurately adjusted underneath when its weight is obviously being reduced above by wear and tear.

If a mountain is always being worn away, it must be gradually losing its weight, and if its streams are carrying away its lost material to the nearest basin, the basin must be gaining in weight. Geodesy has proved that the mountain's loss of weight is being corrected by additions underground, and that the gains by the basin are being corrected by withdrawals of matter underground. Mr. Hayford has suggested that there is a subterranean transfer of matter through the crust from below the basin to below the mountain; and he has called this transfer the "undertow." In March last Colonel Tandy read a paper before this Society on "The Circulation of the Earth's Crust," and he gave an explanation of the "undertow." Colonel Tandy expressed the opinion

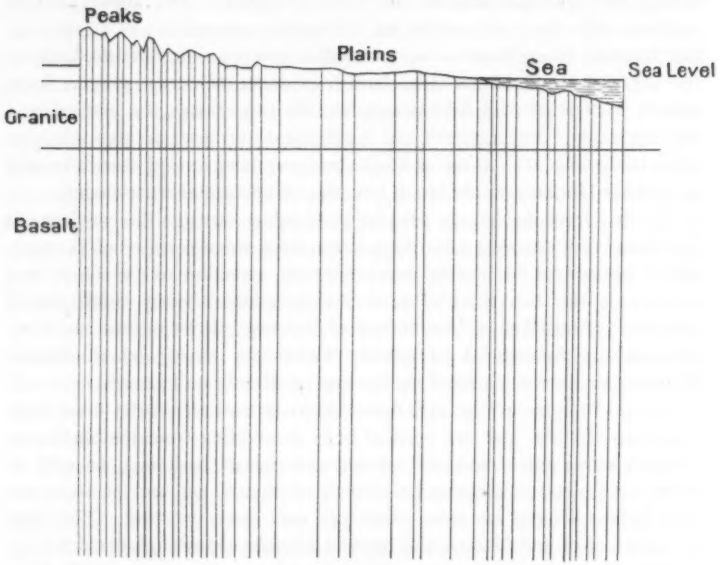


Fig. 1.—Section from mountains to sea.

that the rock-material, eroded from mountain sides, fell down into the valleys, and that it there sank into the crust and flowed back underground to the mountains; by its return flow it raised the mountains in height and restored to them the rock of which they had been denuded above. Colonel Tandy's description of the "undertow" is that of a liquid stream flowing horizontally through the solid crust—from under every valley to under every hill.

Colonel Tandy contends that the falling stones sink by their weight into the crust as though the latter were molten. I have not time in this short paper to review the evidence collected by different branches of science concerning the strength and rigidity of the Earth's crust. But

I may point out that the crust has for ages supported the plateau of Tibet. The isostatic compensation of this plateau does not alter the fact that at sea-level its immense weight is supported by the rocks below it. These rocks show no signs of being crushed, their surface is not yielding. In certain European mines the solid rock has been observed slowly to creep, a phenomenon known as rock-flow; but rock-flow only occurs when man is interfering with nature. No rock-flow has been detected at the base of the Tibet plateau. In my opinion Colonel Tandy's assumption that stones falling from the Tibet mountains sink by their own weight into the crust is not in keeping with the observed fact that the Tibet mass itself stands without sinking.

Also I cannot follow him when he presses the view that the "undertow" is a stream flowing horizontally through the crust. What is the force that produces a horizontal flow? Gravity acts vertically, and gravity is the force that maintains Isostasy. If the Earth were in a fluid state it would have the form of a spheroid. The strength of rocks is, however, sufficient to maintain mountains at great heights, and thus the figure of the solid Earth is irregular. But gravity is able to correct for these irregularities and to keep the Earth's mean figure the same as it would be if the Earth were liquid; in other words, the geoid conforms to the spheroid. Under the action of gravity deep-seated rocks change their density; when a basin is overloaded by silt, gravity decreases the density underneath, and if a mountain becomes too light, gravity corrects the error by increasing the density underneath. If we insist upon the fact that gravity acts vertically, we are forced to the conclusion that a horizontal "undertow" through the crust cannot be justified. Our ignorance of the conditions in the Earth's core debars us from speculating how gravity, acting always in a vertical direction, can balance the horizontal transfers of mass at the surface.

One of the lessons learnt from the researches of Hayford and Bowie is that the rock of the crust is composed of a vast number of vertical columns, some 70 miles in depth, and that these various columns differ from one another in density. The different densities are existing and persisting side by side. The structure of the crust is vertical in character, and its vertical arrangement lends support to the view that mountains have been vertical in their origin.

I have already explained that the chief evidence against this view is the compression of the strata. As I have worked in the area of Himalayan compression for many years, perhaps you will allow me to express the opinions that I have formed.

There have been discovered under the sea several long deep hollows, known as "deeps," very long in proportion to their width. There is one off the coast of Java, another off Japan, and four in the Pacific. There are also similar "deeps" existing on land; there is a great deep extending along the foot of the Himalayas; it is in our time filled up with sand and

silt, and its surface forms the plains of India. Professor Suess, the Austrian geologist, was the first writer to suggest that a deep must be related to the range that stands beside it. The Indian deep is bordered by the Himalayas, the Chili deep by the Andes, the Tuscarora deep by the Japanese and the Kurile and the Aleutian islands, which are the peaks of a submerged range.

Suess called these deeps "foredeeps," because he thought that the ranges were moving forward and that the foredeeps were subsidences in front of the advancing earth-waves. Most writers have admitted that there are objections to the old idea of the Earth's crust being wrinkled into folds; Suess not only upholds this idea, but he assumes that his folds are

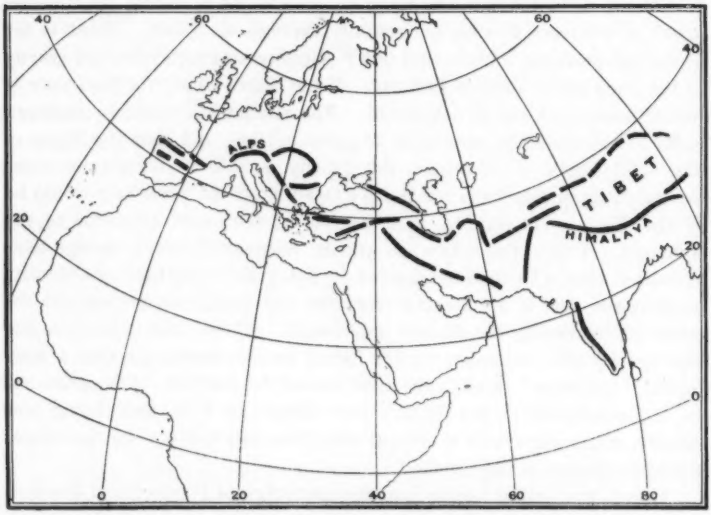


Fig. 2.—Diagram of Alps and Himalaya.

moving across the Earth's surface. He holds that this Indian deep is a subsidence which has left Asia laterally unsupported, and that therefore Asia is slipping southwards.* But he produces no evidence to upset the accepted view that Asia is firmly supported by the rock foundations underneath it. The weight of Asia acts vertically, not laterally, and Asia does not depend upon any lateral support.

Professor Suess is so widely read that I have to ask you to consider another of his conclusions. This long zone of mountains extends from France to China, and it has been shown by geologists to have been elevated in the Tertiary age. We call its western portion the Alps and its eastern portion the Himalayas because the human race is divided into

* "Face of the Earth," I, 596, Sollas's translation; also *Geographical Journal*, July 1920, pp. 37, 38, "The African Rift Valleys," by Professor Gregory.

different peoples speaking different languages; but to the geographer this is one long zone of mountains. Suess contends that Asia has moved southwards because the southern subsidence has removed its lateral support; but he thinks that Europe has lost its northern support in the Arctic regions and that the loss of this lateral support has caused Africa to move northwards and to fold up the surface in front of it into the Alps. So we have the Himalayas created by the moving of Asia southwards, and the Alps created by the moving of Africa northwards; and yet these two independent and opposite movements are supposed to have elevated the crust along the same alignment and to have produced one line of mountains. The geological deductions upon which Suess was building are not in accord with the mechanical or the geographical evidence.

The existence of a deep at the foot of the Himalayas has been proved by both geologists and geodesists. There are other submontane regions where geodetic evidence is forthcoming. One's natural expectation is that a plumb-line suspended within sight of mountains will be slightly deflected towards them by their attraction. Isostasy will decrease the amount of the attraction, but will still leave a deflection towards the mountains. At 60 miles, however, from the Himalayas all the plumb-lines are strongly deflected in the opposite direction; and the only explanation of this curious repulsion is that there exists a hidden deep skirting the hills, and that this deep is filled up with light rock.

In 1871 the Russian Survey reported to the International Geodetic Association as follows (International Geod. Assoc., *Comptes Rendus*, 1871, p. 40): "At the southern foot of the Caucasus the plumb-line is apparently repelled instead of being attracted."

At Zurich the plumb-line is deflected away from the Alps (*Comptes Rendus*, 1903, p. 408). At Neuchatel it is deflected away from the Jura (*Comptes Rendus*, 1890, p. 161, Annexe B, 11). At Bombay and at Mangalore, 30 miles from the foot of the Western Ghat Range, the plumb-line is repelled from the mountains in a remarkable way.* My Himalayan experiences have led me to suspect that these repulsions may be due to hidden deeps, and that many mountain ranges may have deeps beside them, which are not visible to the geologist or to the topographer (Fig. 3).

These mountain deeps are now of primary importance; Hayford's theory of Isostasy has explained all the larger geodetic anomalies except those of one class. This class consists of the peculiar repulsions which have been observed at the foot of mountain ranges.

The error in Clarke's determination of the Figure of the Earth was due mainly to his endeavour to eliminate the seaward deflections at Bombay and at Mangalore.† Recently at the Geophysical Society Dr.

* 'Board of Scientific Advice, India,' 1914–15, p. 68. "Earth's Axes and Triangulation," by De Graaff Hunter, chap. xi.; Profess. Paper, "Survey of India," 17, p. 21.

† The Indian arcs of longitude being near the Equator had great influence in the evaluation of the major axis.

Morley Davies pointed to the seaward deflection at Bombay as evidence of the over-compensation of the ocean. So long as these repulsions are unexplained, they form an argument against Isostasy: I do not believe in this argument. I believe that the cause of these deflections is the presence of attenuated rock in the crust, of which no account has yet been taken in the calculations. We allow in the calculations for the light weight of sea-water compared with rock, and we must similarly allow for the presence of abnormally light rock. It is a difficult matter to estimate the depth to which masses of light rock descend into the crust, and for this reason it is essential that we should try and discover what these deeps are.

On both the Atlantic and Pacific coasts of America (lat. 35° to 45°) there is a tendency for the plumb-lines to be deflected away from the mountainous regions towards the sea.* Bowie has attributed these seaward deflections to the light density of the Cainozoic deposits which form the American coast. This explanation is probably correct, but we still want to know what depth of Cainozoic deposit is required to account for the actual deflections.

The American deflections resemble the seaward deflections at Bombay, and there are no light Cainozoic deposits at Bombay. The Bombay coast is composed of the same heavy volcanic rock as the Western Ghat Range: the difference between the coast and the range is that the horizontality of the strata, which is so characteristic of the mountains, has been much disturbed in the submontane zone. At Bombay the geodetic evidence leads me to believe that a deep exists, but it is not a surface feature. Some of the Pacific deeps are 28,000 feet below the level of the sea, and these deeps must be features of the granite shell which underlies the sedimentary rocks. The long deep skirting the Himalayas is completely hidden by sand; its depth cannot be estimated with confidence; from many calculations which I have made I conclude that this deep must descend below the sedimentary rocks into the granite. When I see a deep depression in the solid crust, I can imagine only two probable explanations of its origin; either it has been formed by vertical subsidence, or it has opened horizontally under tension. The elongated forms of the ocean deeps and of the land deeps do not support the view that they have originated by vertical subsidence. When a hollow in the crust takes the form of a long narrow depression with parallel margins it conveys the idea of a fracture; its form is that of a crack. I think that the deeps may have opened under tension.†

Geologists have given proofs that the beds of the Himalayan rivers have been excavated by the streams; no scientific fact has been more clearly established. But I have frequently seen it suggested that in the first instance the main course of a mountain river may have been decided

* 'Investigations of Gravity and Isostasy,' by William Bowie, 1917.

† "Origin of Himalayan Folding," by Sir T. Holland, *Geol. Mag.*, 10, 167–170. Presidential Address by Sir T. Holland, Section C, Brit. Ass. 1915.

by a fracture in the range. The sections drawn by the Himalayan geologists show that mountains are permeated by fractures; strata are fractured, hill-sides are fractured, boulders are fractured; and water imprisoned behind a range might in the first instance be helped to escape by a rift.

A remarkable feature of the mountains of Asia is that several of the principal river gorges cut across the main ranges at points where the ranges are highest.* The Sutlej escaping from Tibet makes straight for the peak of Leo Porgial, the highest point of the border range. The Indus rushes for 600 miles across the Tibet plateau before it can escape, and where does it eventually find a gateway? At the very foot of Nanga Parbat, the highest peak of the Western Himalayas. The other great river of southern Tibet is the Brahmaputra, and up to 1914 it was not exactly known where this river had effected its escape. But when its course came to be explored by Bailey and Morshead, it was found to have a passage through the mountains at the very foot of Namcha Barwa, the highest peak of the Eastern Himalayas. I have no time to refer to the other instances of rivers crossing mountains near points of maximum altitude, but I have to say that I think we should be wrong in dismissing these phenomena as mere coincidences. I have been gradually led to believe that these main rivers are crossing the mountains on the lines of ancient fractures. I have had the advantage of discussing fractures with a most able physicist in Mr. De Graaff Hunter, and I think that relief of pressure, generation of heat and elastic rebound are among the probable consequences of crustal fracture (*Proceedings Royal Society*, A, vol. 91, 1915, p. 234). I venture to submit the following explanation of the proximity of a river gorge to a high peak—a fracture occurred relieving the pressure in the crust, the granite expanded upwards and formed a peak, the imprisoned water found a passage through the rift.

If this explanation is regarded as worthy of attention in the case of a mountain gorge, it deserves to be considered in the case of the great deep. What the lesser fracture is to the solitary peak, the main deep is to the range. As the peak arose from a relief of pressure in the crust, so has the range arisen from the opening of the deep.

The lower diagram of Fig. 3 is a section across the Himalayas; the dotted portions show the protrusions of granite; the horizontal compression is shown; the plumb-line is repelled from the mountains; the hidden deep skirts the hills. I cannot draw the deep. The Himalayan geologists place its northern edge near the margin of the hills; geodesists would place it a little further north and inside the hills; seismologists would say that the disastrous earthquakes of Kashmir, Dharmsala, Katmandu, struck the mountains with greatest force within the zone of compression; the geological maps that illustrate the forms of the continents

* 'Sketch of Geography and Geology of the Himalaya Mountains and Tibet,' 1907, part iii. p. 185.

before the rise of the Himalayas show a long narrow channel of sea crossing Asia along the line of this deep, but the ancient Mesozoic channel embraced both the deep and the range, and it conveys the idea that the present granite ranges may have arisen vertically out of the original deep.

The question still remains—How has this discussion of the Indian deep assisted the problem of the horizontal compression of mountains? In this way: the main Himalayan range runs parallel to the deep; the

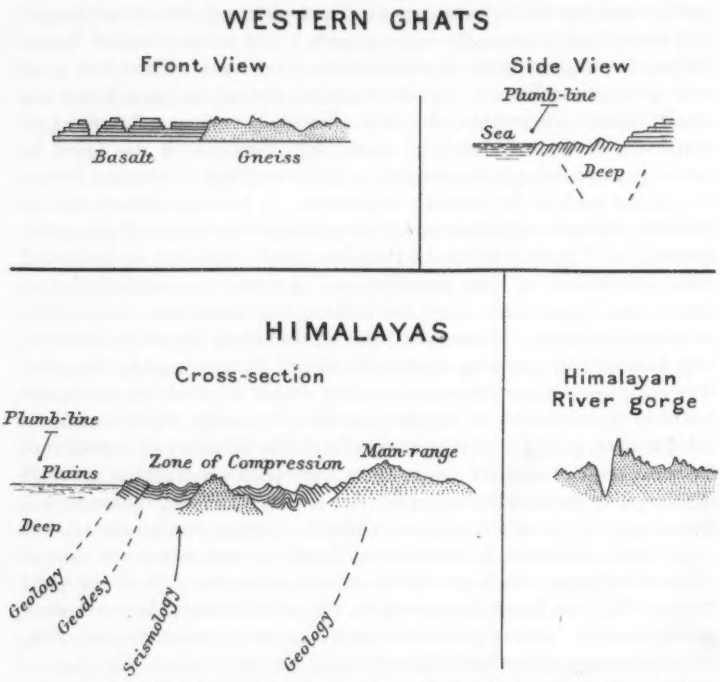


Fig. 3.—Sections showing the "Deeps" of the Western Ghats and the Himalayas.

distance of the main granite outburst from the edge of the deep averages 40 miles; and it is within this zone between the range and the deep that the horizontal compression has been observed. Here we have a zone 40 miles wide, and its surface is one vast rock-ruin: its rocks have been compressed and stretched, depressed and elevated, tilted and cracked: in 19 miles of this zone Middlemiss found a contraction of 8 miles (*Mem. Geolog. Surv. India*, xxiv. 2, p. 77). Is all this rock-ruin due to the shrinkage of the Earth's core away from its outer shell? I have closely analyzed the geological sections by Oldham, Middlemiss,

Hayden, and Vredenburg, and the rock-ruin seems to me to be due to a local cause acting within the zone. The foldings are on so small a scale that I find difficulty in attributing them to a world-wide cause or to Suess's southward advance of the mountains of Asia. It seems to me as if the subterranean rocks in the crust between the deep and the range have been undergoing constant chemical changes. It seems as if the foundations of this zone had been expanding and contracting, and as if their contortions had crumpled the rocks above them. Even within this zone the granite has protruded in many places from below, and the zone itself is one of the principal seismic regions of the Earth.

DIAGRAMMATIC SECTIONS ACROSS THE HIMALAYA (AFTER HAYDEN)

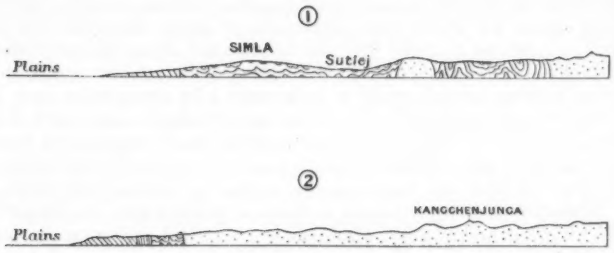


Fig. 4.

Whilst therefore there is evidence of compression in the Himalayas, I do not think that there is any evidence that the Himalayas have been elevated by compression.

My experiences have been confined to one region, and it is possible that they may not accord with the views of those who have studied mountains elsewhere. The problems involved will not be solved by one branch of science or in one locality. I hope that by expressing my own opinions I may induce others to express theirs.

Before the paper the President said: There is no need for me to introduce to you Sir Sidney Burrard, the late Surveyor-General in India, because he has already been before us this session. We are very glad to welcome him here again this afternoon, and I will now ask him to read his address.

Colonel Sir Sidney Burrard then read the paper printed above, and a discussion followed.

Dr. MORLEY DAVIES: The subject which Sir Sidney Burrard has introduced is one of very great difficulty and complexity, upon which the opinions of geologists have changed so much from time to time that it would be very unwise to be at all dogmatic. But there were certain views expressed by Sir Sidney Burrard on which I should like to comment. He refers to the rigidity of the Earth, and, pointing out that gravity acts in a purely vertical direction,

draws the conclusion that horizontal transference of matter cannot result from it. I am not a physicist, and I speak on matters of physics with great fear and trembling lest I should use terms inaccurately. But, from discussions with those able to judge, I gather there is no incompatibility between the Earth as a whole having the rigidity of steel and portions of it being susceptible to deformation of shape as the result of long-continued stress. Unfortunately, geological terms are largely influenced by the old ideas of the liquidity of the Earth, so that the term "undertow" is used to express the horizontal transference of matter in the depths of the Earth counterbalancing the lateral transport at the surface. But if we consider those supporting columns shown on one of the diagrams as extending to a depth of 70 miles, when there is a transference of matter from the tops of the mountains to the bottom of basins, the greater weight on the supporting columns of the basins will tend to make them bulge laterally. By lateral deformation of that kind I fancy that quite sufficient compensation can take place for the surface transport. But Sir Sidney Burrard's view of the adaptation of the supporting column to surface changes seems to credit the Earth with characteristics which have hitherto been regarded as confined to living organisms. One has always supposed that if you pile extra weight upon the ocean basins, the effect upon the density of the supporting columns beneath would be to increase it by compressing them, and if you remove large masses of matter by denuding mountains, the effect, if any, on the supporting columns, would be that they would expand and become lighter. But Sir Sidney Burrard's view is exactly the opposite: that when you remove pressure from the mountains the supporting column underneath, in order to restore isostasy, proceeds to become heavier, and the supporting columns under the ocean basins, when they become silted up, become lighter. I do not see how that can come about unless through some sort of nervous system which will enable the Earth to adapt itself in an indirect way. As regards Dr. Fermor's idea to which Sir Sidney Burrard has referred, of the elevation of mountains by molecular changes in the rocks beneath, there is this difficulty: it may explain how mountains and depths once formed are maintained, but not how they are initiated. It is one of the well-known facts of geology, that over and over again we find thick masses of sediment, all of shallow-water type, showing that the sea-floor has sunk just as fast as the sediments have accumulated. If we try to explain this by simple hydrostatic replacement, we are met with the difficulty that light material cannot depress the heavier layers below it to an extent equal to its own thickness. If, on the other hand, we try to explain it by actual compression of the deeper layers, the principle of isostasy is not satisfied, because the total mass of the supporting column is increased. But if you combine the two things—if you have the sinking taking place partly by displacement and partly by compression—then you can satisfy the principle of isostasy exactly. And the same thing applies, *mutatis mutandis*, to the elevation of mountains. So I can see how by combining displacement with compression or expansion you can continue to depress your depths or elevate your mountains, just as fast as the ones are filled up and the others denuded down, but I cannot see how you are going to start the process in either case. The only way to start expansion would be by a diminution of pressure, and that can only be got by denudation, and you must have mountains there to be denuded. What we want is a cause of mountain-elevation in a region where a depression exists, for all the evidence seems to show that the sites of mountain chains are previously occupied by deep sea.

Dr. HUME: This subject is of much interest to me, because we are seeking to obtain fuller information as to the origin of our mountain ranges in Egypt. I may briefly state how some of us in that country are approaching this question. Looking at the case of the Red Sea area, it certainly does appear as if a large anticline was originally formed there, giving rise to a continental surface. The beds composing it were formed during the Cretaceous and Eocene periods, and as they rose above the sea to become the land surface, they were eroded into ridges and depressions. Two methods of obtaining deeps have been mentioned. Another suggestion may be offered. It seems probable that when an anticline of great breadth is rising, it does not do so as a whole, but is thrown into a series of secondary folds. This would explain the presence of such depressions in the Red Sea area, and might help to do so elsewhere. In the region bordering the Gulf of Suez the mountain ranges on both sides are very conspicuous. I have traced their boundaries over large areas both in Egypt and Sinai, and have found that the strata are tilted against the granites and other ancient rocks at extremely high angles. Two explanations have been submitted for such occurrences. One is Prof. Gregory's suggestion of vertical subsidence, the other the view expressed by Dr. Ball that compressional stresses can alone have caused the conditions observed. To me uplift has seemed the most satisfactory explanation of the higher ranges. Between them is a series of folded strata, the condition mentioned by Dr. Morley Davies being observed in the basin portion of the folds, viz. the presence of great thicknesses of gypsum and salt (at least 3000 feet in places), while immediately adjoining them are the lower granitic ranges, in which we also see evidence of uplift also. These points require further discussion, but at present the differences in height between the Red Sea Hills and Sinai Mountains (7000 and 8500 feet respectively above sea-level in round figures) on the one hand, and the lower ranges (only 1400 feet above sea-level) on the other, seem best explained by vertical or lateral uplift as described by Dr. Morley Davies. We have as yet insufficient data to consider the phenomena in relation to isostasy.

Dr. HAROLD JEFFREYS: I agree entirely with Dr. Morley Davies's remarks. We all know of scientific theories that were once widely accepted, and have since been abandoned. I think the thermal contraction theory of mountain-building is on the opposite footing, that of a thoroughly sound theory, capable of fulfilling all demands on it, which has been dropped for no satisfactory reason, and should be restored. Osmond Fisher's estimate of 100 feet for the greatest possible height of the mountains that could be produced by thermal contraction was obtained by finding the volume of rock that would be crumpled up on the theory, and assuming this rock spread out uniformly over the surface of the Earth. His estimate of the height of the mountains is the depth of this deposit. But if all our known mountains were powdered and spread out uniformly over the surface of the Earth, they would not cover it to a depth of anything like 100 feet. The proper way of carrying out a comparison is to find the *area* of the Earth's surface that would be crumpled on this theory, and to compare it with the reduction that appears to have taken place in the formation of mountains. I carried out this comparison in a paper in the *Philosophical Magazine* for 1916, and found that the compression available was about twice that needed. Apart from this mistake, it was clear that Osmond Fisher's work needed revision from the discovery of radioactivity, which upset the whole of the Kelvin theory of the cooling of the Earth, upon which Fisher based his argument. Taking radioactivity into account, Holmes found it possible to

satisfy all the thermal conditions required by geology, and it is on his numerical results that my estimate was based.

I do not think that a contracting Earth would necessarily wrinkle either in all ages or in all parts. This argument seems to leave out of account the strength of the Earth's crust. A small contraction would only cause a small horizontal stress on the outer layers, which could be sustained without change of shape. Crumpling does not start until the stress has become so great that the strength of the crust is no longer enough to support it, and when once it has started it must spread. Thus the fact that all the chief mountain ranges were uplifted in one geological period is a natural consequence of the contraction theory. The view that wrinkling would occur all over the Earth, again, seems to involve the assumption that all rocks have the same strength. On the thermal contraction theory, however, the suboceanic rocks are more basaltic and have cooled more than sub-continental rocks, and on both grounds must be stronger. It is very probable, therefore, that they could sustain stresses that would be enough to cause crumpling within a continent. It is quite possible that no considerable crumpling under the oceans has occurred to this day. This is confirmed by the existence of the Pacific type of mountains. When a compressed ocean floor abuts on a compressed continent, the first to yield will be the continent, and thus we get a long range, like the Rockies and Andes, running parallel to the coast.

The evidence quoted by Sir Sidney Burrard about the Western Ghats and Tibet certainly supports the idea that they were uplifted without compression; but if so, there is still more compression available to account for other mountains. I should like geological evidence as to the possibility of the transmutation of rocks to the extent required by the theory Sir Sidney has offered. The height of Tibet is about 10,000 feet, so that to get it uplifted on account of a ten per cent. change of density requires that the depth of rocks altered should be 100,000 feet, or practically 20 miles. I should like to know whether this is plausible. Gravity, of course, cannot produce horizontal movement; but if a column of rock at one place is heavier than a column of equal cross-section at another, the pressure at the bottom is greater, and the difference of pressure at the bottom gives rise to a horizontal force which can do all the moving of rock that is wanted. Without such horizontal transference isostasy could never be readjusted after denudation. For mere vertical expansion and contraction caused by changes of density does not affect the mass in a vertical column, and therefore makes no important difference to the distribution of gravity.

Dr. J. W. EVANS: We always welcome a paper by Sir Sidney Burrard, for we know what splendid work he has done in connection with the Geodetic Survey of India. We know that he has made India the foremost country in the world so far as concerns the study of the variations of gravity from point to point, and the good work is now being carried on by those who have come after him on the staff of the Survey. But of course we reserve the right to our opinions on the very difficult questions he has brought before us this afternoon. As he himself says, the problem we have got to consider is, Have the mountains been lifted by horizontal compression of the crust or by vertical uplift from below? Sir Sidney Burrard tells us that so far as his knowledge of the Himalayas goes there is no evidence that there were ever sedimentary strata which were arched over the granite masses which form the core of the mountains. That may be so in the case of the Himalayas, although I can scarcely reconcile it with a great deal I have read on the subject, but it is not true with regard to the portion of the Andes with which I am personally acquainted, nor of those

denuded mountain chains of which we can see the ruins, so to speak, in our own country. There we have every evidence that contraction and folding took place in long-distant days, and formed ranges of mountains probably no way inferior to the Himalayas, and most of the writers who have described the structure of the Alps have come to similar conclusions. Now Sir Sidney Burrard finds great difficulty in accepting this theory of the formation of mountains from folding due to contraction. His first difficulty is based on physical grounds. He says it involves, as is clearly the case, the movement of the surface relative to the interior. He says that this is entirely inconsistent with the rigidity of the Earth's crust, and indeed, of the Earth as a whole, which has been repeatedly proved by various considerations—by earthquake waves, by the effect of the attraction of the heavenly bodies and the variation in position of the terrestrial pole. These clearly demonstrate that the rigidity of the Earth as a whole is even greater than that of steel, and near the surface at least equal to that of steel. Now that is not in any way inconsistent with the possibility of a relative movement of the Earth's crust. Suppose I took a steel sphere and pressed it for a minute or two against a steel plate. The sphere would be distorted under the pressure, but when the pressure was relieved it would be restored to its former shape. It would behave as a rigid substance which possesses the quality of elasticity. But if the same pressure were to be applied, not for a brief period, but for a thousand years (or even less than that) it would be found that the steel was permanently distorted. For long-continued pressure, acting always in the same direction, results in progressive distortion, whereas pressure acting only for a short time leaves no permanent result. The vibrations of earthquake waves act only for a few seconds, and those of the heavenly bodies only for a few hours. But under long-continued pressure of a sufficient amount the substance of the Earth's crust, as is evidenced by the existence of the equatorial bulge, flows like pitch. The question next arises as to the possible cause of the lateral compression in the earth's crust. The difficulty to my mind is not the difficulty of finding a cause, but to choose amongst them. There is first the contraction by cooling of the Earth's interior, which was long considered to be insufficient, but, as you have heard, that by no means appears to be the case. But there are other possibilities. The interior of the Earth has been losing all through the geological ages an enormous amount of gas and volcanic products, and the result inevitably means that the volume of its interior is less than it was. There is still another cause that operates in the same direction. The Earth is believed to be slowing down, the velocity of its rotation is diminishing, and it is probable that the length of the day millions of years ago was very much less than it is at present. The result must be that the Earth approximates more closely in form to a sphere than before. We all know that the surface of the sphere is the least surface that contains a certain volume of matter; therefore, the more a body approximates to a sphere the less surface it has for the same volume. Its former crust would therefore be too large for it. There is yet another closely connected cause. If the centrifugal force is less, as it will be if the rotation slows down, the pressure on the interior of the Earth will be increased, and the interior will be therefore compressed and decrease in volume, and for this reason also the surface will be too great for the interior. There are other considerations, but I think I have said enough to show you that there is no difficulty in finding reasons for believing the crust of the Earth is becoming progressively larger relative to the interior. These explanations apply to the whole Earth, but there are also local causes affecting particular areas. In the first place, the slowing down of the Earth's

crust would cause the circumference of the equator to become less, so that the whole equatorial region would be exceptionally compressed, and we should expect in that region north and south lines of mountains to predominate. There is also the action of the Earth tides caused by the moon and the sun, resulting in an unequal retardation of the Earth's crust, and a general disturbance of the relative positions of different portions. We know that the Earth's crust is not uniform but contains a number of solid masses formed of ancient folded rocks where the crust is thicker than elsewhere and the strength greater. These are like masses of ice in an icefloe, and any such movement as I have suggested will alter the relative positions of these masses, giving rise sometimes to tension, sometimes to compression in the regions between them; the latter is, I believe, one of the most frequent causes of mountain building. I think I have said enough to show that those who believe in the contraction theory of mountains have not such a very bad case after all.

Sir Sidney Burrard argues that the presence of remains of elephant and rhinoceros in the Tibetan tableland was evidence that it had risen in recent times, and without any accompanying folding. I think I am right in saying that the former is *Elephas primigenius* (the mammoth), which lived in this country at the time of the Glacial Period, and the latter *Rhinoceros tichorhinus* (the woolly rhinoceros), which accompanied it. Both were as well capable of taking care of themselves under Arctic conditions as the reindeer.

It must not be supposed from what I have said that I do not welcome in the strongest manner a paper like this. I think that the problems of mountain building, of the variation of gravity from point to point, require more attention than they have yet received, and I hope that both topographical and geological surveyors and engineers generally will follow the example Sir Sidney Burrard has set, so that India will no longer be an isolated example of what can be done in scientific research on the Earth's interior, but that it may be taken as a pattern in every part of the British Empire. We have a wide Empire extending over a great part of the world, and I trust that we shall prove ourselves worthy of it, and show that scientific research will everywhere follow the flag just as surely as commerce is supposed to do.

Mr. HINKS: I have noticed that the geodesists always seem to accept, without any question, that depth of 70 miles which arises from Hayford's deductions, and in a few remarks after Colonel Tandy's paper I ventured to say that in my opinion those figures were exceedingly ill-founded. I welcome the opportunity of asking of the great experience of Sir Sidney Burrard, whether he is not able to agree with me. It is a technical point belonging to the theory of least squares. Hayford made five solutions, in which he took different values for what he calls the "depth of compensation." Those five values were first, zero; secondly, infinity; and third to fifth, quantities not differing very much from one another, but of the order of about 70 to 100 miles. He formed five solutions, and the sums of the squares of the residuals in his equations of condition were something like this in thousands: 65 for infinity, 13 for zero, and 8 for the other three depths. From the very slight difference between the three latter values he deduced that 70 miles was the most reasonable depth of compensation. A long and sad experience of least square solutions makes me think there is exceedingly little in this argument. Those sums of squares were so nearly alike in the three latter cases, that I don't think any reliance can be placed on the 70 miles; it is not impossible that say 160 miles would have given a more favourable result if he had tried it. I would submit then that there is no arithmetical reason for sticking very

closely to this 70 miles. Might I be allowed to call Dr. Evans' attention to a very brilliant lecture, which he has perhaps overlooked, by Osborne Reynolds, which startled Cambridge about 1903, and which was published afterwards in a little book called 'An Inversion of our Ideas concerning the Universe,' in which he described some beautiful experiments showing how a granular medium can expand under pressure?

Colonel Sir SIDNEY BURRARD: I feel I have a difficult task. I must first thank Dr. Hume for what he told us about the Gulf of Suez, which was extremely interesting to me. I have often seen it, and was glad to hear of the work he is taking on there. He is perhaps the only speaker to-night who has not taken me to task for something. My critics have this advantage over me, that they saw my paper beforehand, and I did not see what they were going to say. I will first refer to what Dr. Morley Davies said about under-tow. If you have isostasy in a crust, if there are different densities side by side in columns in a crust, it is evidence that the conditions in that crust are not hydrostatic; I think that geodesy has shown that the isostatic shell reaches down, I won't say exactly 70 miles, but to some depth of that order; below that depth there is possibly a hydrostatic core, but I do not think that hydrostatic conditions exist in the crust. Most of you know the experiments of Adams, who is the greatest authority now on the crushing strength of granite. When we are discussing the strength of the crust it is of no use considering the sedimentary rocks at the surface: we have to consider the granite shell underlying them, and Adams found that granite will bear 30 miles of a granite column before it crushes. He also found that small cavities will remain open in the crust at depths of 11 miles at temperatures of 500° Centigrade, and that these will remain open at greater depths if filled with water. Now with regard to what Dr. Davies said about the bulging of the sides of the columns and the lateral deformation of these vertical columns in the crust. I do not think that there is any bulging of the sides of those vertical columns, or any horizontal passage of matter through these columns, because wherever we test the compensation we always find it accurate, and this supposed bulging of the columns would destroy the accuracy of compensation. You would have extra density being bulged from a dense column into light columns. As far as we can see, compensation takes place, compared with geological time, very rapidly. During our own time on Earth we find that mountains and seas are already compensated, so this is a condition that supervenes perhaps momentarily. I do not think the idea that an isostatic shell must be very weak is based on any direct evidence. The existence of isostasy is supposed to prove that the Earth's crust is wanting in rigidity. But what really happens is that there is a tug-of-war between gravitation and rigidity. Gravitation tries to pull down Mount Everest, and the rigidity of the rocks resists the pull of gravitation, and there is a tug-of-war between them. You cannot say that gravitation has won, for there is Mount Everest standing firm. Something gives way in the crust, the column under Everest becomes compensated, and the tug-of-war ceases. With regard to the question of deltaic deposits in shallow water, great and deep deposits are said to have always been made in shallow water, and to have been always sinking and sinking; it has been held that they go on sinking under the weight of fresh deposits, and in some way or another this has become connected with isostasy. Captain Dutton, the American geologist, is often quoted in this matter. I think it is rather unfair on him to quote him now; he wrote forty years ago, when isostasy was in its infancy; he saw these deposits of great depth, and he connected them with isostasy, but now that Hayford has taught

us more about compensation, we see that the sinking deposits have no connection with isostasy. If you compress the crust, it does not help isostasy in any way. When a river piles up a huge delta on the crust, it does not produce isostasy if the crust is compressed. When a delta is being piled up, isostasy can only be brought about if the density underneath is decreased. What is the evidence that these deposits sink under their own weight? I do not deny that in rare cases they sink, but I question whether their sinking is due to their own weight. I have read of a case on the coast of Italy where there was a castle, and for some centuries (I am speaking from memory now) it sank under the sea and became covered with marine shells; it might have been argued that the weight of this castle was making the coast sink; but after a time it began to rise again and it now stands on dry land! I believe that the Baltic is now a sinking area, but it is not sinking under any surface weight. If you look at the big deltas of the Nile, the Ganges, the Mississippi, you will see that silt is being poured out into the oceans; and it is not sinking into the crust. The Tigris is gradually filling up the Persian Gulf, and Dr. Pilgrim, the geologist, stated that the shores of the Persian Gulf are actually rising at Bushire and Jask. The only delta, as far as I know, which is building up deposits in a sinking basin, is the delta of the river Helmand in Central Asia; there the deposits are very deep and are sinking, but they are not sinking under their own weight. This is a river which cannot find an outlet to the sea, and naturally it finds out the lowest point it can. Its deposits will be naturally formed at one level because if the crustal subsidence becomes more rapid at any time, the gradient of the river becomes increased and there are more deposits to fill the depression; if the subsidence ceases at any time the gradient becomes so slight that the deposits cease. Dr. Davies and Dr. Evans even went so far as to make fun of some of the geodetic theories. They, I think, said that they did not believe that pressure could produce a decrease of density. Dr. Davies said that I was giving nerves to the rocks, and Dr. Evans compared it to Einstein! I do not like to speculate on what goes on at great depths, but it seems to me, from the observations of geodesy, that there are isostatic columns in the crust and that their densities are readjusted by hydrostatic pressure from below. I say this with some diffidence, because I know that seismologists insist on a solid core. I was very interested to hear that Dr. Evans presses the idea of horizontal folds in the crust, and that he is supported by the mathematician Dr. Jeffreys; that is a formidable combination; if this meeting had been held forty years ago, mathematicians would have been against the geologists, and I acknowledge that geodesists must reconsider and see if they cannot reconcile their results with folding. One of the objects of a paper such as this is to bring out these opinions. Dr. Jeffreys referred to radium, but as far as I understand it, I do not know that radium has altered the old views of the Earth's cooling. These views were based on the temperature gradient in the crust, and that was determined by experiment. He also referred to the strength of the crust under oceans being greater than that under continents. But if you take a section of the Earth's crust, the surface features are seen to be extremely small, and when we deal with depths in the granite shell, there are no grounds for assuming the strength of the crust under continents and oceans to be very different. With regard to what Dr. Evans said, that changes in rotation-velocity produced contraction, we have to remember that we are not trying merely to find a cause for the Earth contracting as a whole; we want to learn why the core has contracted and not the crust. With reference to the discoveries of Richard Strachey in Tibet, I have never seen his deductions

questioned by Indian geologists. He has the reputation of being a capable geologist, and he was the man who found the fossil bones of elephants; the deductions I gave you were his deductions. But if Dr. Evans is right in saying that Strachey's elephant and rhinoceros were Arctic species, then I know that the argument for vertical elevation is weakened. With regard to what Mr. Hinks said concerning Hayford's depth of 70 miles, Hayford has devised a very remarkable system. All the theories which we put forward to assist scientific inquiry must be based upon observed facts, and that theory is best that fits the most facts; Hayford has produced a theory of compensation, and wherever you apply it it fits the facts, and this is a tremendous argument in its favour. He made this discovery from observations in America. We applied it in Tibet—quite a different part of the world and under different conditions—and we found it fitted. Two or three years after Hayford had introduced his theory, the geodetic world were anxious to see how the numerous observations in the Alps would respond to Hayford's methods; the Swiss geodesists reported that the mountains of Switzerland had moved about horizontally as shown by the geological theories, and that it was out of the question to expect to find them compensated, and that they did not think it necessary to go to the enormous trouble of Hayford's computations. So Hayford selected some of the Alpine stations himself and made the calculations himself, and he found his method suited the Alps accurately. Hayford's method has fitted the observed geodetic facts all over the world. It is a most difficult matter for each plumb-line station to have to calculate the compensation-effect of every hill on the earth. Think of the labour; and Hayford, in order to make such a system possible, introduced this depth of 70 miles. He is the only man who has shown us how we are able to compute the facts of the whole topography of the Earth for every geodetic station; he has shown that the effective compensation of the topographical features of the Earth's surface is concentrated at about 25 miles' depth.

The PRESIDENT: When we look up at the Himalaya mountains the height seems stupendous, and we think that the force needed to raise them to that altitude must be titanic. But these are days of "relativity." And relatively large as they appear in comparison with the size of a man, the mountains are relatively insignificant when compared with the size of the Earth as a whole. The average height of the Himalayan range may be taken roughly as 4 miles. The diameter of the Earth is about 8000 miles. On this 15-inch school globe which I have before me the Himalayan range would be represented by a protuberance not more than $\frac{1}{133}$ inch high—that is about the thickness of a thick sheet of note-paper; and any ordinary mountain range would be represented by a rise of the thickness of a thin sheet of note-paper.

What we have to account for is the rise of these insignificant elevations of the Earth's surface. And we have no need to seek for a force capable of raising these eminences in one sudden effort. The process of elevation is most gradual, for we know that it has taken at least a million years to raise one of the greatest mountain ranges. A fair way, therefore, of stating the problem would be this: "What is the force which can, in about a million years, cause an elevation on the Earth's surface not greater in proportion than the thickness of a sheet of note-paper to a school globe?" When thus stated the problem has a less formidable aspect than it presents to us when we stand under a Himalayan giant and wonder what titanic force must have been at work to raise these mountain masses to such stupendous heights. Now in seeking a solution of this problem, we must take regard of two facts of fundamental importance—

firstly, that the Earth is a highly sensitive body, quickly responsive to outside influences; and, secondly, that it is part of the whole great Universe with which it is intimately connected and from which it is unceasingly receiving impressions. When we are considering happenings to the *surface* of the Earth the importance of these two facts will be at once recognized. Sir Sidney Burrard insisted on the solidity of the Earth and upon the crust being as rigid as steel. And this may be perfectly true. But it is also true that the Earth in its ultimate composition is made up of particles of matter—electrons—which in the quite literal sense of the word are in *unceasing* motion and which are sensitively responsive to outside influences. The crust of the Earth may be as rigid as steel, but it has not by any means those characteristics of immobility and irresponsiveness which the rigidity of steel suggests. Within it is in a fury of activity. The Earth is entirely composed of these self-active electrons, mere centres of energy, which group themselves together as atoms and groups of atoms in ever-increasing complexity, but which are all alike and all very sensitive. The Earth is therefore a very impressionable body. So when the powerful influences—like light and radiant heat from the Sun—come raining down upon the Earth they do not pour off the surface like rain off a duck's back; the impressionable Earth absorbs them and responds to them. The Earth—and, of course, more especially the surface of the Earth—quickly responds to the impressions it receives from the outside Universe; and the results of the interaction of the Earth with the rest of the Universe we may see all round us to-day. We may select from among these results some which indicate the existence of forces which uplift bodies in defiance of the force of gravitation dragging them down.

One example we may take is a cloud. Despite the tendency to gravitate towards the centre of the Earth drops of water are raised under the influence of the sun to heights higher than the highest mountain. Trees furnish another example. Responding to the light and heat in the Sun, and to other influences bearing upon them from the Universe, particles of the Earth's surface raise themselves upward in the form of trees and maintain themselves erect for hundreds of years. Clouds and trees are instances of the way in which the sensitive particles of which the surface of the Earth is composed, responding to and in interaction with the various forms of energy in the Universe at large, have elevated themselves to great heights in dead opposition to the downward-dragging tendency of gravitation. May not these examples give us the clue to where to seek the force which raises mountains? May not the slight upheavals on the Earth's surface be due to the sub-atomic energy locked up in the rocks in interaction with cosmic energies of many kinds? May not the elevation of mountains be due to the activities of highly sensitive electrons acting in response to the impact of energies incessantly pouring in upon the Earth's surface from the Universe at large?

What I would suggest is then that if we want to find the force which uplifts mountains we should look for it in the heart of the atom and in the heart of the Universe as they interact upon another. As light and heat and all the other forms of energy which go to convert the hydrogen and oxygen atoms of the Earth's surface into water, and inorganic compounds into organisms, impinge upon the electrons which compose the Earth's surface, the electrons group and re-group themselves into atoms of differing elements, while the atoms in their turn group themselves into varying compounds. And from this interaction between the Earth and the rest of the Universe there result those heterogeneous mixtures of rock which compose the crust of the Earth, and those

physical and chemical changes—those variations in the volume and density of the rocks—to which Sir Sidney Burrard has alluded and to which he attributes the elevations of the Earth's surface.

The atoms would always be tending to gravitate towards the centre of the Earth. But the evidence of clouds and trees shows in that the concentrating tendency of gravitation is more than balanced by an excentrating tendency impelling the atom to fly *outward*—that is, to those appropriately situated, *upward*, and from the operation of this force will have emerged those elevations of the Earth's surface which to us appear great heights, but which in reality are only of the order of the thickness of note-paper in comparison with a school globe. So it is in the interaction of our highly impressionable and responsive Earth with the multifarious energies of the Universe at large that I suggest to you we shall find the ultimate origin of mountains. From this cosmic interaction—the action between Earth and the other parts of the Cosmos—is generated an excentrating, uplifting force (or complex of forces) which, acting in successful opposition to the concentrating, lowering force of gravitation, raises mountains as it raises clouds and trees.

THE ROSS SEA DRIFT OF THE "AURORA" IN 1915–1916

J. M. Wordie

THE story of how the *Aurora* broke away from her moorings at Cape Evans, Ross Island, on 6 May 1915, and drifted helplessly in the pack ice for nearly a year, has already been partially told by Sir Ernest Shackleton in 'South.' The extracts which he gives from her captain's log were selected to illustrate how the party carried on during the winter and the ensuing summer before the ship was free again, and in a more or less crippled condition finally reached New Zealand. References are made to her position from time to time sufficient to give a fair idea of her track. A somewhat similar story, based on a newspaper report, is told by Dr. Mill in the *Geographical Journal* for 1916 (vol. 47, pp. 372–374). Commander Stenhouse, however, the captain during the drift, very wisely thought that the full and correct details of the ship's drift should be made available, and to this end gave me his diary last spring, at the same time asking me to work out the course, etc., with a view especially to comparison with the *Endurance* and the other Antarctic drifts.

The material available consists of a type-written copy of his diary made in New Zealand in May 1916, and a list of corrected longitudes from October 1915 to April 1916. Unfortunately, many of the loose sheets of the diary, most of them dealing with the first month of the drift, are missing. Commander Stenhouse volunteered to get the original sent over from New Zealand, and telegraphed and wrote accordingly, but without satisfactory result: the original may eventually be found, and if so will of course add a few more details. A more serious loss, and which cannot be made good, is that of a bundle of diagrams and drawings, some

of new land possibly, and others of the little-known Oates Coast, which were left at the *Daily Chronicle* office in 1916 for better security during the war: these also have disappeared, and their recovery is most unlikely.

From every point of view it would have been better to have worked from the original log and work-books, and to have had Commander Stenhouse's own chart before me. There is uncertainty, for instance, about a few positions, probably due to copying errors, which might have been cleared up by reference to the originals. This being impossible, the only other course open is to omit them altogether. Only positions about which there is no doubt are shown. A very useful check is supplied by the force and direction of the wind, which was recorded daily in the diary.

The positions fall roughly into two sets: those up to August 23, in which the longitude was obtained from bearings to mountains or capes on Victoria Land; and those from September 22 onwards, in which the longitude was worked out by chronometer. Neither set is entirely satisfactory. As regards the first, Victoria Land has never been very accurately charted; and, moreover, the magnetic declination was seldom checked or observed. As regards the second set, the chronometer rate was found to have altered very considerably by the time the ship finally got into wireless touch with New Zealand. The original positions were corrected accordingly, the difference sometimes amounting to between 3° and 4° (*e.g.* in 64° – 66° S. lat.). In both series, even with these corrections, it would certainly be unwise to claim a closer accuracy than 10 miles. Commander Stenhouse says in one place, "The bearings as laid off on a small chart of gnomonic projection are very inaccurate, and here we are handicapped as our chronometers have lost all regularity"; and again, "The temperature in the chart-room ranges from zero to a little above freezing point. This is a very disturbing factor in rates of the chronometers, which are kept in cases in a padded box, each case covered by a piece of blanket and the box covered by a heavy coat."

The *Aurora* broke away from her moorings at Cape Evans at 9.45 p.m. on 6 May 1915. In the first five days the wind blew a moderate gale from east-south-east, south, and then south-south-east; and by the end of the week the ship is stated to have drifted 45 miles. She was carried to the west side of McMurdo Sound, and was somewhere off Granite Harbour between May 14 and 22. She apparently went diagonally across the sea to the north-west, and in this was merely following the route which parties on Ross Island have seen bergs taking in summer. These come round Cape Bird from the east, and after drifting a little southwards into McMurdo Sound move straight across to Granite Harbour; their route is governed partly by a true current, partly by the force and direction of the wind. On May 24 a second blizzard from south-south-east carried the ship rapidly to a position about 20 miles east of the Nordenskjöld Ice Tongue, and here she remained several days till variable winds,

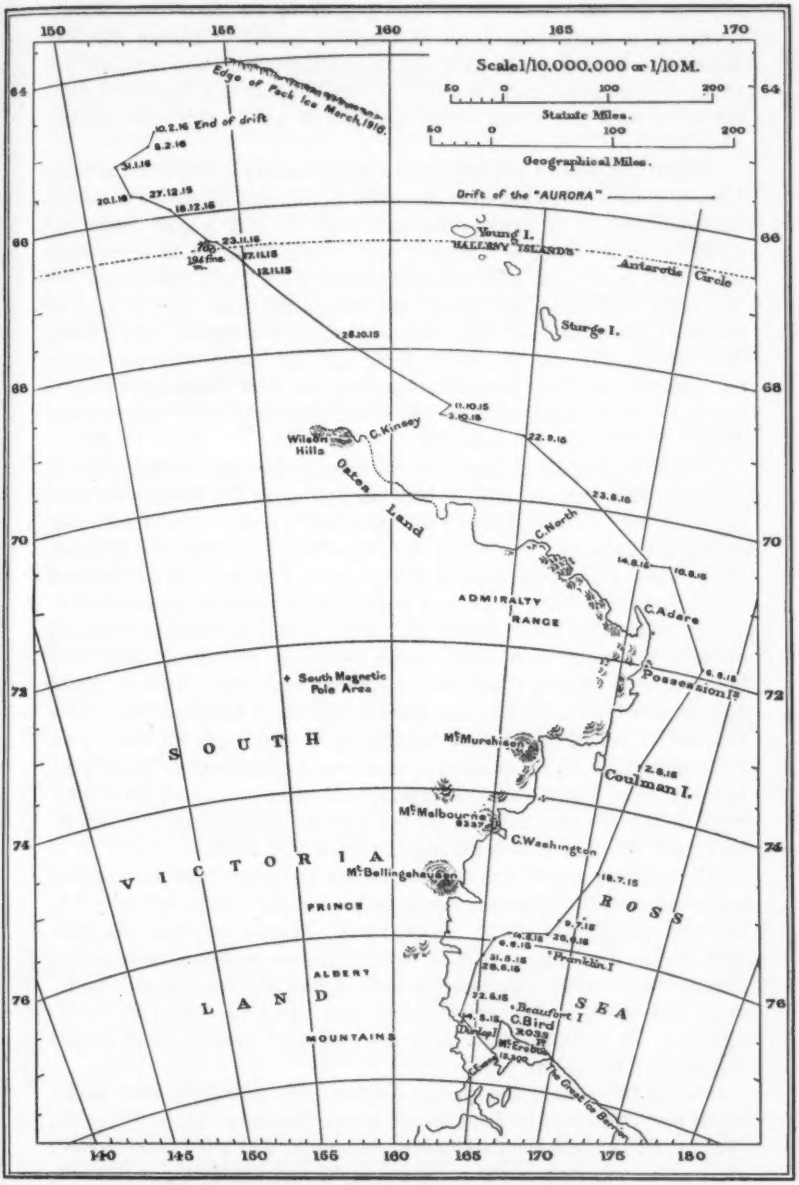


Chart showing the drift of the "Aurora" in the Ross Sea.

and then persistent westerlies of force 3–4, drove her about 60 miles east-north-east to somewhere north of Franklin Island. "During the last westerly blow the ship's position has altered appreciably and her head has swung through south to south-west. It would appear that Franklin Island has acted as a hub round which the field of ice in which we are has wheeled."

From July 9 to 18 the ship drifted fairly steadily to the N.E., averaging 5–6 miles a day, wind force generally 3. Then a succession of south-south-west winds of force 4 between July 18 and August made her travel N. by E. about 6–7 miles a day. From August 2 to 6 the wind blew hard from south and south-south-west, force 8–10, and drove her 100 miles N.N.E. in that time; and in the next four days a wind of the same force, but from south and south-south-east, drove her 88 miles N.W. by N. The rate of drift of these last eight days has no parallel in the Antarctic, and can be matched only in the East Greenland Current. She was now due north of Cape Adare, and the course so far followed was roughly parallel with the coastline.

During the middle of August the prevalent winds had all something of easting in them; she travelled N.W. about 7 miles per day between the 10th and the 23rd. From August 23 till September 22 the rate of travel only averaged a little over 2 miles per day; this was a slow rate, and to judge by the winds it can be accounted for by a good deal of back and forward drifting over the same ground—a feature which positions determined at long intervals does not of course bring out. From the middle of August onwards the mean north-west course (whatever the details may have been) is very striking; the rate, however, was very variable. From September 22 to October 11 the average rate was 4 miles per day; from October 11 to 25, eight; from October 25 to November 23, four; from November 23 to December 18, two; and from December 18 to January 20, just over one. At the end of January, however, the steady N.W. drift came to an end: from the 20th till the 31st the ship drifted 27 miles N. by W. and then in the next ten days 47 miles N.E. by E.

On February 10 she was free to use sail and steam once more, but it was another month before she finally quited the pack ice in 64° 27′ 30″ S. lat., 157° 32′ E. long. on 14 March 1916. Though very near the pack edge during this time, as almost daily references to heavy swells prove, progress was very slow, as, owing to lack of fuel, she was generally under sail. The month's work amounted to only 130 miles in an E. by N. direction. It looks, therefore, as if the region of westerly winds begins just north of 65° 30′ S.

During this nine-month period only two new soundings were made, whose positions could be fixed definitely: on November 17, in 66° 40′ S., 154° 45′ E., 194 fathoms, dark-brown glacial mud and a few small stones; and on November 24, in 66° 26′ S., 154° 17′ E. (or thereby), 700 fathoms, no bottom. More soundings would have been welcome, but at any rate

these two definitely fix the position of the edge of the continental shelf north of "Cape Hudson."

During the drift along the Victoria Land coast, various landmarks were passed in turn—Mount Melbourne, Coulman Island, and Cape Adare. On August 23 Commander Stenhouse says: "Saw the land in the vicinity of Cape North: to the south-south-west the white cliffs and peaks of the inland ranges were very distinct, and away in the distance to the south-west could be seen a low stretch of undulating land." Thereafter there were numerous glimpses of the land, and on September 22 a rough sketch was made of Oates Coast. More of this land was seen bearing south-west on October 3; and the next day a very prominent peak was noticed, probably farther east than the Wilson Hills. On October 14 there was land to the south and south-west, probably Cape Kinsey and the Wilson Hills. Finally, in November, land was seen to the south very far off; if correct, this last observation extends Oates Coast 80–90 miles farther north-west beyond the Wilson Hills.

On November 23 land was seen bearing N. 54° E. (true); it was thought to be Young Island, Balleny Group, but the direction does not agree. Later in the day land was seen bearing S. 60° W.; this was supposed to be "Cape Hudson," and was described as a "high, bold headland with low undulating land stretching away to the south-south-east and to the westward of it." The next day, however, the weather was very clear, and not a vestige of land was to be seen in either of these directions. The appearances of the day before were simply mirage. On November 16 the Balleny Islands were thought to be visible to the east; there is some little doubt apparently, but on a previous occasion, September 22, they had actually been seen, for on that date Sturge Island was sighted bearing due north (90 miles), and appearing like a faint low shadow on the horizon.

There are now four well-observed drifts in the Antarctic: the *Belgica*, south-west of Graham Land; the *Deutschland* and the *Endurance*, in the

	Date.	*Latitude.*	*Longitude.*	*No. of Days of Drift.*	*Dist. point to point.*	*Rate per day. Sea miles.*	*Dist. sum of courses.*	*Rate. Sea miles.*
Belgica Beset ...	2 Mar. 1898	71° 30′ 0″ S.	85° 15′ 0″ W.	376	333	0·9	1706	4·5
Free ...	13 Mar. 1899	70° 50′ 0″ S.	102° 15′ 0″ W.					
Deutschland Beset	8 Mar. 1912	73° 40′ 0″ S.	31° 0′ 0″ W.	261	630	2·4	1633	6·3
Free	26 Nov. 1912	63° 42′ 0″ S.	36° 20′ 0″ W.					
Endurance Beset	19 Jan. 1915	76° 34′ 30″ S.	31° 30′ 0″ W.	447	900	2·1	1816	4·1
Free	9 April 1916	61° 56′ 0″ S.	54° 5′ 0″ W.					
Aurora Beset ...	6 May 1915	77° 38′ 0″ S.	166° 24′ 0″ E.	282	800	2·8	1191	4·2
	12 Feb. 1916	64° 49′ 0″ S.	152° 40′ 0″ E.					

Weddell Sea, and the *Aurora*, in the Ross Sea. Two others are less important: the to-and-fro drift for a couple of months of the *Antarctic* in the north-west corner of the Weddell Sea, and the besetment of the

Gauss off Wilhelm Land. Neither of these ships drifted over any distance or for any length of time. The four first-named (see table) illustrate the westerly drift of the pack round Antarctica, and show that this drift is practically parallel to the coast.

A comparison of the rates of drift is important, for an idea of the relative amount of pack in the various areas may perhaps be deduced from it. The comparison can be made in two ways. To measure point-to-point distances is one; but in this case the tracks of the *Aurora* and the *Deutschland* are curved like a bow, and that of the *Endurance* also, but to a less extent; whilst the *Belgica*, except in the last two months of her drift when she travelled rapidly westwards, drifted mainly back and forwards over the same ground. This method is therefore only satisfactory for comparing the somewhat similar tracks of the *Aurora* and the *Deutschland*; and gives the *Aurora* a 16 per cent. faster rate than the *Deutschland*. The other method is to work with the sum of the distances between observed positions. In the case of the *Belgica*, *Deutschland*, and *Endurance* this gives quite satisfactory results, for in all three cases positions were determined every three or four days; so that the rate so got is very nearly the daily one. The respective speeds following this method are 4·5, 6·25, and 4 sea-miles per day. For the *Aurora*, however, this method is quite unsuitable, for positions were only fixed about once in ten days. Presuming, however, that she drifted in much the same way as the *Deutschland*, but 16 per cent. faster, her daily rate works out at 7·3 miles per day.

That the *Aurora* and *Deutschland* travelled so much faster than the *Endurance* is due perhaps, but not with certainty, to stronger winds. During the *Endurance* drift, however, it was found that the same wind strength made the floes travel very much faster when nearer the pack edge. The view is therefore taken that the *Aurora* and the *Deutschland* drifted faster than the *Endurance* because they were both nearer the edge of the pack.

In the latter part of her drift the *Aurora* was probably in the area of westerly winds; and, if she had not won free when she did, she might quite easily have undergone the back and forward experience of the *Belgica*. In the latter's case, though on the whole she was south of the region of westerly winds, yet, as Arctowski shows, there were seasons when the westerly system did extend as far south. Speaking as a whole, this was the most interesting side of the *Belgica* drift—this and the sudden dash westward in the last two months.

Whether or not the *Endurance* track ran parallel to the unknown coast of Graham Land has yet to be settled: but the striking way in which the *Aurora* follows the Victoria Land coast strengthens the probability. Only once did the latter ship break away from the coast, namely in June, when the wind blew steadily from the west: it is just likely that this was due to the big glacier on the adjacent coast, which acts as a funnel. But for this, the track of the *Aurora* makes a grand sweep right along the coast, round Cape Adare, and away to the north-west.

THE MOUNT EVEREST EXPEDITION

AT the time of writing the last news of the Mount Everest Expedition is given in the telegram despatched by Colonel Howard-Bury from Tingri Dzong on July 16 by runner to Phari, and published in *The Times* of August 17.

On the last stage of the journey to Tingri further difficulty had been caused by rinderpest in the valley of the Bhong Chu, apparently the name of what has been shown on the maps as the principal western branch of the Arun, though, from a reference to Kharta as "a collection of villages in the Arun valley," it is clear that the map is seriously wrong. The only transport to Tingri was by donkey, and the possibility that no yaks might be obtainable for the mountain party caused us some anxiety, now happily relieved by the news that Messrs. Bullock and Mallory had left Tingri on June 23 with 18 coolies and 4 yaks for the first exploration of the mountain's north-western face.

The base camp was established at Tingri, with headquarters in the Chinese rest-house assigned to the party by the Tibetan authorities, who have continued to show all friendly courtesy to the expedition. From the photographic dark-room installed there Colonel Howard-Bury has sent home a large first consignment of pictures taken on the way, which are now exhibited in the photograph-room of the Society. We hope to publish in the *Journal* for October, and thenceforward monthly, a selection of these pictures, and as soon as possible a map based on the work of the surveyors, whose results we await with some impatience, for it is at the moment quite impossible to follow the reports of the expedition.

The first disposition of parties was as follows: Captain Wheeler, of the Survey of India, was starting his photographic survey at Tabra (Keprak on the map, near the Pusi La), and Mr. Heron of the Geological Survey was with him, or near by. Major Morshead was working north to connect with the surveys of Colonel Ryder on the Brahmaputra. Mr. Wollaston, who had reached Tingri on June 22 after leaving Mr. Raeburn to convalesce at Lachen, was busy collecting the rich flora and fauna of the Tingri district, and intended to extend his work to the interesting neighbourhood of Gosainthan. Colonel Howard-Bury, in a letter from Tingri dated June 25, proposed to leave on the following day to visit the Pusi and Khombu (Pangu) passes and Lapche Kang, "a sacred place of pilgrimage where the old Sanskrit poet is buried," and then tour along the base of the 26,800 and 25,000 peaks until he found the mountain party, returning thence to Tingri.

The last telegram, of July 15, must have been sent on the completion of this programme, but covers only the early history of the mountain party, who had established a camp at 18,000 feet on a shelf above the left-hand margin of the Rongbuk glacier, and on July 5 had climbed a

23,000-foot peak above their camp, as a training excursion for the coolies. The north-western face of Mount Everest has an almost sheer cliff of 10,000 feet to the head of the valley, with difficult rock below the summit of the peak: so that even if the cliffs could be turned, the north-western face did not appear promising. About the end of July Colonel Howard-Bury proposed to move his base to Kharta and reconnoitre the north-eastern and eastern faces, which seem to be less steep, with more snow.

While the topography of the whole region remains very obscure, the cablegrams from the chief of the Expedition picture to us a land far from inhospitable, with large monasteries and villages hitherto unknown; valleys with soft grass and bubbling springs; hermits and nuns in cells or caves under the very precipices of the mountain; wild animals and birds coming to feed from the hand. In this idyllic place the mountain party—sadly reduced by the death of Dr. Kellas and the illness of Mr. Raeburn—have found themselves facing 10,000-foot precipices which bar the way. How greatly will they on their return regret that the painter and the poet could not this year be added to the strength of the party!

Colonel Howard-Bury reports that up to July 7 the weather had been very favourable for the reconnaissance and for the surveys. The following week gave hail and rain, with snow at the higher camps, but by the end of July the north-west face of the mountain would have been sufficiently explored.

We have every reason to congratulate the Chief of the Expedition on his excellent progress in spite of unexpected difficulties. The 300 miles from Darjeeling to Tingri was covered in thirty days, which included several of enforced delay. No time was lost in getting to work from Tingri. The mountain party were at the base of the mountain well before the end of June. By July 16 the surveyors had mapped 6500 square miles of country; the photographic and geological surveys were well in hand; the natural history collections abundant; the despatch of photographs from the expedition already well begun. All promises well for a highly successful first season, even though it is already clear that the mountain will not disappoint the mountaineers by proving unexpectedly easy.

MEMORIAL TO SIR CLEMENTS MARKHAM

THE Peruvian Government did a signal honour to Sir Clements Markham and to the Society when they asked permission of the Council to erect at the door of the Society's House a Monument to the memory of our distinguished ex-President. The proposal being gratefully accepted, the Peruvian Legation commissioned Mr. F. W. Pomeroy, R.A., to make a bust in bronze, which has been placed on a pedestal of Istrian marble in the bay to the right of the door.

H.R.H. the Princess Louise, Duchess of Argyll, graciously consented to unveil the memorial on the afternoon of Wednesday, July 20, and at the joint invitation of the Peruvian Chargé d'Affaires and of the President of the Society, a distinguished company assembled, including the leading members of the Peruvian Colony in London, representatives of the Markham family, and of Westminster School.

The Peruvian Chargé d'Affaires, Señor Don Ricardo Rivera Schreiber, speaking in Spanish, expressed in the name of the Government and People of his country their gratitude to Sir Clements Markham as a distinguished writer and geographer, who devoted a great part of his arduous life to the study of Peru and to the history of the Incas. In handing over the monument he declared that his country would never forget the name of Markham, and that in the ancient land of the Incas, which he loved so much, his name would always be mentioned with respect and affection.

Sir Maurice de Bunsen (Foreign Secretary, R.G.S.), replying in Spanish, thanked the Chargé d'Affaires for the happy and friendly terms in which he had expressed, on behalf of the Peruvian Government and People, their fidelity to the memory of Sir Clements Markham.

The President then asked the Princess Louise to unveil the Memorial, which had been covered with the flag of the *Discovery* that is preserved in the Society's Museum; and afterwards expressed to Her Royal Highness the thanks of the Society and of the Peruvian Government for her kindness in performing the ceremony.

The sculptor is to be congratulated on his success in deriving, from very insufficient material, a very satisfactory likeness of Sir Clements Markham. He took much trouble to consult members of the family and many friends of Sir Clements, and could hardly have succeeded better in the always difficult task of making a posthumous portrait.

The inscription on the pedestal, below a badge with arms of Peru, reads thus:

This Monument to the Memory of
SIR CLEMENTS MARKHAM,
K.C.B., F.R.S., & for 12 years President of the
Royal Geographical Society
was erected in the year 1921
by the PERUVIAN NATION
in Gratitude for his Services
as Historian of their Country.

A Society skilled in Cartography is especially critical of lettering. After much discussion, a monument in Westminster Abbey, of date 1786, was chosen as a model of what the lettering should be. Mr. J. H. Reynolds very kindly lent a rubbing of that inscription, and the mason has been very successful in cutting an especially pure and beautiful type.

REVIEWS

EUROPE

On Alpine Heights and British Crags.— George D. Abraham. London: Methuen & Co., 1919. Size 9 × 5½. Pp. x. and 308. *Illustrations. Price 10s. 6d. net.*

MR. ABRAHAM has set himself a difficult task in writing a book of climbing reminiscences. It is hard to keep the reader's attention fixed on chimneys, faces, pitches, and courses even with the conventional Alpine comic relief. Moreover, the thrills and perils of mountain gymnastics have been pretty thoroughly exploited. In 'Alpine Heights and British Crags' the reader can take his fill of them. The author may be considered one of the foremost exponents of up-to-date rock climbing. He writes of climbing in the Swiss Alps, the Dolomites, and the British Isles. The mountaineer may perhaps wonder how far the modern rock-climber oversteps the limits of justifiable risk. Indeed, the new rock school seem to have created a new danger for mountaineers—that of falling off the mountain. The very existence of such a danger was denied by the optimists of the days of the mountaineering Badminton. According to their theory a good climber, as long as he was careful, could never fall. It is true that bits of the mountain might fall on him, but it was his business to avoid the places where such things could happen. Nowadays rock specialists by their extraordinary agility and daring contrive to reach situations from which they can only extricate themselves with the help of more good luck than they can reasonably count upon. At least it would appear so, judging from some of the incidents described.

As is usual in books by this author, the photographs are excellent.

Russia in the Eighties.— John F. Baddeley. London: Longmans. 1921. Pp. 482. *Portrait and Sketch-maps. 30s. net.*

Mr. Baddeley places opposite his title-page, not his own portrait, as most writers of autobiography would, but that of Count Schouváloff, sometime Russian Ambassador in London, the life-long friend who obtained for him, at the early age of twenty-five, the responsible post of correspondent of the *Standard* at Petersburg. The years he spent there (1879–1888) were eventful, and he was an intelligent observer as well as a *persona grata* at all the Embassies. In that decade Imperial Russia reached the zenith of her greatness as a European and Asiatic power. Her formidable position prompted the constitution of the Triple Alliance, and in consequence her own *Entente* with France—the grouping of the Powers which subsisted at the opening of the war of 1914. The author's scenes show the busy workings of diplomacy, the now vanished pomps of the Winter Palace, and the pleasant outings for sport, whether bear and wolf hunting in the forests or trout fishing in the Finland waters. Alongside of the gay life of the capital marched the sombre spectre of Nihilism, at one time flashing into light with the murder of Alexander II., and at all times mining underground in preparation for the explosion of after-days. It is well that this chapter of Russian history should be recorded: it supplies materials for estimating the value of Imperialism—had it only been wise—in the case of such a people as the Russians are; and it is fortunate that it should have been written for us by so competent a hand. A. G.

The Treaty Settlement of Europe: Some Geographic and Ethnographic Aspects.— H. J. Fleure. London: Humphrey Milford (Oxford University Press). 1921. Pp. 83. *Price 2s. 6d. net.*

The changes made by the recent treaties in the map of Europe have been so vast that it is eminently desirable that they should be discussed as fully as

possible, from many points of view and by many different persons. Unfortunately, however, the conditions which exist in the printing trade at present, combined with the attitude (and the income) of the book-buying public, render this comprehensive treatment very difficult. The form in which Prof. Fleure's pamphlet is issued is an illustration of these difficulties. It belongs to a series, called The World of To-day, which may be regarded as the equivalent of those dealing similarly with important subjects which were being placed on the market in some numbers in the period just prior to the war. Economic factors are exerting their influence not only in the greatly increased price at which such volumes are now issued, but also on their contents and format. As compared with the 50,000 words which were a common limit of size in earlier series, we have here about 30,000 words. Further, the paper covers make careful study and preservation difficult, and the sketch-maps, many of which are of great interest so far as conception goes, are so badly reproduced as to be in cases all but illegible. The last fact is especially important, in view of the small size of the book, for it means that details omitted from the text cannot be represented on the maps. Since, again, the general plan of the book involves the setting forth of the main outlines of the territorial changes, while its author has also much that is fresh and suggestive to say on the broad aspects of the various treaties, we have necessarily excessive compression, with the result that attractive trains of thought cannot be fully worked out.

The most interesting chapter of the five which make up the book is undoubtedly the first, entitled "A Short Survey of European Life," and it is here that the want of room to develop a thesis adequately is most felt. Space only permits us to say that Prof. Fleure distinguishes as "Europe of the Sea" the area west of a zone stretching from the Gulf of Danzig to Bukovina and the Carpathians; and apart from the swamps in this belt, he lays emphasis on the eastern limit of the beech, and the limit of the sway of the Catholic Church, as indications that it forms a frontier zone. Within the region of "Europe of the Sea," as thus defined, he regards the Rhine–Danube line—that is, the limits of the area administered by Imperial Rome—as forming another frontier belt, to the west of which the idea of the nation-state developed. In Eastern or Interior Europe, in his opinion, the idea of the sovereign nation-state did not come into existence till the progress of industrialism had rendered it largely out of date. The book should certainly be read by all interested in the wider problems of European and world politics in their geographical bearings, and will prove invaluable to teachers and students.

There are a certain number of misprints, mostly of a minor kind; but Bolzono for Bolzano (p. 69) should be noted for a future edition, since the name is still relatively unfamiliar here as replacing the familiar Bozen.

Belgium.— **Emile Cammaerts.** London: Fisher Unwin. 1921. *With 35 Illustrations and 9 Maps.* Pp. 357, including Index. *Price* 12*s.* 6*d.*

Monsieur Cammaerts warns his readers that his 'Belgium,' in the Story of the Nations series, is neither a series of essays nor a systematic text-book, but rather the story—in chronological order—of important events in Belgian history which illustrate characteristic features of Belgian civilization and development. This is only part of the truth; for the book is not only written with a distinction which makes it worth reading as literature, but is also of extraordinary interest to geographers, especially in the earlier chapters. In fact, the first half is a most admirable analysis of the fate and function of an area that is naturally a "Buffer" belt.

This is the essential theme, illustrated from every epoch and every aspect

of Belgian history since Roman times; and the author justifies his claim that Belgium at every epoch has expressed with almost unique fidelity the civilization of that epoch—imperialism in the ninth century, communalism in the thirteenth, centralization in the fifteenth (under princes who, though foreigners, were so much inspired by interest in Belgium that they may fairly be called natives), industrialism, reaching out to colonization, in the nineteenth.

Behind this power to interpret the spirit of the age, M. Cammaerts sees the influence of environment, race, and speech, with their triple dualities—dualities which, so far from hindering, helped her to play her great part between East and West, North and South. The story begins with Rome, building round the edge of the Silva Carbonaria, "the Coal Wood," the great longitudinal road—much older, therefore, than its mediæval name, "Road of Bonnelant," suggests—crossing at right angles river after river that flowed from south to north, and so deciding the position of the Norse camps where the rivers were bridged at the head of navigation, *e.g.* Louvain and Maestricht. The Roman Church worked with the rivers, latitudinally, rather than with the road, longitudinally. Its aim—maintained for 800 years, and nobly revived by Cardinal Mercier—was to unite the two races; its ecclesiastical boundaries never ran east-and-west, and entirely ignored the language line, linking in one community and creed, "Walas" and "Dietschen." It was precisely because he was so typically Belgian in these respects that Godfrey was chosen by the polyglot Crusaders as their chief. Under the same environment Charlemagne had made Aix his pivot, and Charles V. made Brussels his pivot; and Belgian princes were all normally interested in peace, and so exercised a sobering influence between France and England or Germany, a Count of Hainault even refusing passage through his territory to the armies of Frederick Barbarossa when seeking the same advantage as the Germans sought in 1914.

Of course, the shield has two sides, even if the conditions essentially responsible for periodic ruin made also for the parallel restoration. The factors that favoured the Communes, with a minimum of political obstacle and a maximum of economic advantage, in substituting their economic subdivisions for the political subdivisions of Feudalism, were extremely unfavourable to any strong centralization or the unification of the nation under a national prince; and they made possible the iniquitous decrees of Vienna, which "suited every nation concerned except those most concerned—the Belgians." M. Cammaerts exercises great restraint and courtesy in all references to Holland, but no amount of courtesy can ignore the fundamental injustice of a settlement which deprived Belgium of all the advantages of her great superiority in population, and saddled her with half of the terrific national debt of Holland. Indeed, the book adds to its literary distinction an admirable object-lesson in the blending of patriotic enthusiasm with scholarly restraint and impartiality.

L. W. LYDE.

ASIA

In Farthest Burma.— **Captain F. Kingdon Ward.** London: Seeley, Service & Co. 1921. Pp. 312. *Sketch-maps and Illustrations.* 25*s.*

It is a fortunate circumstance that the wealth and variety of the flora of Western China should of late years have attracted several English botanists to that region, for in their zeal for botanical discoveries they have been able to explore much new ground and to add considerably to our knowledge of the geography and ethnology of this most fascinating borderland.

Captain Kingdon Ward has already given us in 'The Land of the Blue

Poppy' a very valuable and readable account of the Tibetan and semi-Tibetan country lying on the upper waters of the Mekong and the Salween. In the present volume he describes a journey that he made in 1914 in the hilly regions of the upper Irrawaddy, the extreme north-east corner of the Indian Empire where the Kachin Hills of Upper Burma abut on China to the east and on Tibet to the north.

The greater part of the Kachin Hills was brought under British rule in the late eighties and early nineties of the last century, soon after the annexation of Upper Burma. To the east the Chinese frontier is not far distant from the Irrawaddy valley, and in this direction the country was naturally soon occupied right up to the border. To the north the case was different. Here from Myitkyina, our most northerly civil station, there stretched an almost unknown land inhabited by Kachins and other wild tribes right up to a vague Tibetan frontier, 200 miles off measured in a straight line, and far more than this by any path which might exist. Neither strategically nor commercially were these forest-clad hills of any value, and the inhabitants, with the possible exception of the Hkamti Shans, certainly did not pine for British rule. In the early nineties, therefore, an east-and-west line was drawn, roughly about the latitude of the confluence of the Mali Hka and the Nmai Hka, the two branches of the Irrawaddy. To the north of this line our Government did not administer the country, and its inhabitants remained practically independent.

This state of things continued till 1911, when encroachments by the Chinese on territory which was undoubtedly within our boundaries led to British columns being sent out, and in the next two or three years to the occupation of the country as far north as Hkamti. Captain Kingdon Ward had not therefore here the opportunity, as in his former journey, of being the first explorer in unknown places. But if the ground was not unexplored or unmapped, it was at any rate not fully described. Doubtless official reports have been written, but these are not readily accessible, and Captain Kingdon Ward's book is the first detailed account of this country that is available to the public.

The author is certainly to be congratulated on having taken full advantage of his opportunities, and on having produced a thoroughly readable book. He has a great gift for describing scenery, and has the happy knack of conveying information as to the country and its inhabitants in a pleasant and interesting manner. His knowledge of botany, natural history, and geology enables him to note many details which would be missed by a traveller unversed in these sciences. The map which accompanies the book is a mere sketch, but is sufficient to enable the reader to follow the author's path. As several parties of the Survey of India have been over this ground, it was unnecessary for the author to do any surveying himself.

Captain Ward devotes a good deal of attention to the tribes of this frontier, the Lashis, Marus, Lisus, Kachins, Nungs, Hkamti Shans, and others, and gives many details of their dress, character and distribution. Perhaps the most interesting of these are the Hkamti Shans, a small community of that very numerous Shan race which spreads over Northern Burma, Siam, French Indo-China, and all the south-western provinces of China. Here in the little Hkamti plain they have maintained a fairly civilized existence surrounded by the much more warlike Kachins and other wild tribes, and entirely cut off from the other branches of their own people. Some excellent photographs give a good idea of the appearance of the different tribesmen, and add much to the value of the book.

The author, in order no doubt to find the flowers at their best, made a great part of his journey in the summer, and consequently suffered considerably from wet weather and from insects. The future traveller in this region would do well, if he is not specially interested in botany, to time his travels for the drier winter months.

A few small errors may be noted. Should not the Feng-shui-ling of chapter iii. be Fen-shui-ling, *i.e.* Watershed Range? I should not like to assert this positively, but the latter name is very common in China, and seems the more probable of the two. The photographs of "Cane bridge over the Ngawchang River," and "The Monastery, Putao Village," have been transposed, and consequently the wrong page numbers are given in the List of Illustrations at the beginning of the book. In the footnote on p. 42, "Appendix II." should be "Appendix I."

Such small mistakes are scarcely worth mentioning, and do not detract from the value of a most interesting book of travel in a hitherto undescribed country. It is much to be hoped that Captain Kingdon Ward will continue his explorations on this frontier, and will give us the result of his observations in some more volumes of this kind. There is still much unknown ground here.

H. R. DAVIES.

Early Travels in India, 1583–1619.— Edited by **William Foster, C.I.E.** Oxford: University Press. 1921. *12s. 6d. net.*

British Beginnings in Western India.— **Hugh George Rawlinson.** Oxford: Clarendon Press. 1920. *Sketch-maps and Illustrations. 7s. 6d. net.*

The pioneers of British enterprise in the East have always been prime favourites with the students of the great ventures of our countrymen in foreign parts. Alone, or by twos or threes, they made for the centres of a society and civilization entirely strange to them, and there, in the midst of danger and difficulty, they compassed their aim with a courage, pertinacity, and resourcefulness which bequeathed an easier task to their successors. Amid all their anxieties, too, they kept their eyes open to the characteristics and resources of the different parts of India which they visited, and to the vivid and picturesque style of their narrative can be added the general accuracy of their observations, to which modern investigators have borne witness.

Until the recent publication, under Mr. Foster's editorship, of Sir T. Roe's account of his mission to Jehangir, the record of these experiences had to be sought for in the numerous and portly volumes of Hakluyt and Purchas, or traced to rare or forgotten pamphlets. Now that the relations of this country to India are entering, in certain aspects, a new phase, a brief account at first hand of how those relations were first established is opportune. The editor being again Mr. Foster, it may be safely assumed that the selection of the travellers and the arrangement and annotation of their letters or journals are what they ought to be. Particularly useful is the fitting of each contribution into the picture by means of a short prefatory biography. There is thus presented a general view of life in the Mughal dominions as it appeared to seven intelligent, and on the whole sympathetic, Englishmen of an era of high adventure. The field of their survey was comparatively limited since they all made straight for the court of the Emperor, which ranged between Lahore and Ahmedabad though resting longest near the western bank of the Jamna. A few entered India from the north-west, but most landed at Surat and made their way up country by the Tapti and Central India, or by Ahmedabad and Ajmir. Some, again, like Fitch and Withington, took opportunities for lengthy excursions to Pegu and Lower Sind respectively, but their business

was to stick close to the court until they had secured the trade or the concession they wanted. Notwithstanding wide differences in personality and opportunity, the travellers are in general agreement as to essentials. The accounts given by the merchants show the greatest sameness, while the most comprehensive and circumstantial narrative is that of the chaplain Terry, who, though he saw less of India than the rest, had the privilege of being for some months the host of the incomparable "globe-trotter," Tom Coryat. The two letters from Coryat himself are especially interesting, as Mr. Foster has reproduced them from the original pamphlets, whereas Purchas made extracts only. So, too, in the case of Withington, the editor has supplied a full reprint of the original diary. The aid of scholars of to-day has been enlisted abundantly in the elucidation of names of places and people and in the transcription of the Indian words generally. The work, then, may be summed up as an interesting and convenient guide to an important phase of our early efforts at peaceful penetration.

Mr. Rawlinson's book and Mr. Foster's are complementary to each other. The one depicts the efforts of the early travellers to find out what were the resources and trade openings of India, and then to negotiate for a footing in the country; the other is, as it were, an intensive study of that footing when gained, and the uses to which it was put. In regard to the earlier years, therefore, the authors cover a good deal of the same ground, though Mr. Rawlinson is less concerned than Mr. Foster with events in upper India. The general object of the pioneers was to establish a centre through which to tap the trade of India, and to secure a share in the then more lucrative spice trade with the Far East. This implied a challenge to the maritime supremacy of Portugal in Eastern waters. For all these purposes, Surat was the most convenient port. It was the main export centre of the Mughal dominions, the gate of Mecca for Muslim pilgrims, and was surrounded by country rich in natural products and manufactures. Some years passed, however, before the obstacles raised by the Portuguese were overcome. In the long run, British merchandise prevailed over Jesuit diplomacy at Agra, and, after varying fortunes, the Portuguese fleet was driven south, and "got into a hole called Bombay," a hole then meaning merely a safe anchorage, without any aspersions upon the adjacent settlement. Sixty years later the position was reversed, and British headquarters were formally transferred from Surat to "the better hole."

The book is well written and put together. Having access to the records of the East India Company both in India and in London, the author is able to correct many mistakes found in the works of his predecessors. By judicious selection, too, from the somewhat diffuse contemporary authorities, he concentrates the attention upon one highly important phase of our relations with India, on which he will be found a helpful guide. In one or two points of no particular moment he is open to criticism. For instance, he attributes greater authority to the Partition Bull of 1493 than is now generally allowed to it (cf. June *Journal*, pp. 435–433). Again, it is not safe to accept Terry's hearsay account of the burial of poor Tom Coryat at the mouth of the Tapti, about 12 miles from Surat. At all events, about half a century ago, there were remains of tombs not far from the north-eastern gate of the city, which tallied with the account given by Herbert of the place of Coryat's burial; but they were swept away by floods about 1887. Finally, neither of the two English factories can now be traced, though the sites are known approximately and are covered by modern houses. J. A. B.

AFRICA

The Secret of the Sahara: Kufara.— Rosita Forbes. London: Cassell & Company. 1921. *Map and Illustrations.* 25*s. net.*

This book will surprise, even disappoint, an avid public worked up by the limelights directed of late upon Mrs. Forbes. It is not conceived sensationally, and conveys hardly an echo of the brass bands which have blared before, behind, and on either hand its authoress ever since she emerged from the desert. There is a note of exaggeration, but not more pronounced than is expected of desert travellers. Hillocks must swell to mountains, hamlets to cities, and the meagre palm-garden to a luxuriant paradise when one has trudged for a week towards a receding limit of monochrome horizon. Mrs. Forbes is to be commended for refusing to play up to the fantastic claims made for her achievement and herself. She sought and went through a gallant adventure, and she tells the story of it very well.

She and Ahmed Mohammed Bey Hassanein took bold advantage of a change of Senussi heart, due equally to certain events in an obscure side show of the Great War, and to the decay of the Order's original spirit of ascetic exclusiveness. It has followed the usual psychic curve of such Orders, and is now on a downward path towards luxury and mendicancy. Mrs. Forbes notes that the Akhwan have fallen away from the ideals of El Mahdi, but does not see apparently (or will not allow) that when the head of a Moslem Confraternity, having failed to cadge a temporal title from one Christian Power, begs it of another, the end of his religious importance is in sight. Under the circumstances the two adventurers had comparatively little to fear from man in making for the once forbidden sanctuary of the Senussis, under guarantee from chiefs who knew perfectly well who they were. But they had much to fear from what Mohammed Idris could not control—forces of singularly ill-conditioned Nature. If they availed themselves with courageous decision of a favourable psychological opportunity (and Mrs. Forbes especially deserves credit for foreseeing and preparing for her opportunity), they faced with even more decisive courage the waterless and virtually uncharted desert, under conditions of travel that repel even Bedawins. Mrs. Forbes manages to convey to her readers, not only the discomfort and danger of crossing some of the emptiest tracts on the globe, but also the hideous monotony of it. Not merely does she describe admirably her daily wayfaring over limitless flats, but throws their dreariness into relief by bursts of enthusiasm for blessed apparitions of sand-dunes, stunted brushwood, sand-choked palms. It is the outstanding merit of her book that the thoughts and feelings it records convince one that they were thought and felt under stress of events, and not during subsequent reflection in an armchair.

The geographical information which Mrs. Forbes gives is about as much as could reasonably be expected to result from a journey taken under such conditions by two pioneers who were not expert surveyors or even trained geographers. They had no surveying equipment, nor could they have ventured to use it had they taken one along. They could, and did, keep notes of general direction, determined by furtive reference to a concealed compass; of times of marching and halting; and of mileage doubtfully estimated by a meter bound to a camel's knee. The last device involved them in too much risk to be consistently employed. The map that has been produced of their tracks is, therefore, a precarious sketch, which cannot be expected to displace the chart of their predecessor, Rohlfs. So far as it is inconsistent with the latter (as in regard to the principal oasis of Kufara) judgment must be suspended, till the

Italians open up the country sufficiently for a triangulation to be made. For the rest, surveying apart, there is little for a geographer to do in a region so singularly destitute of features, animate or inanimate; and the descriptions of what these two travellers, ill equipped though they were, saw with their eyes will go far to satisfy any curiosity that has been felt about this desolate bit of the world. Its secret is out, and there really seems little else to be done about it. In revealing it Mrs. Forbes has pricked a bubble. The mystic retreat of the Senussiya proved a very small place of no actual economic importance, and unlikely to acquire any under the present and probable conditions of African trade. Mrs. Forbes does not always admit conclusions which follow on her own premises; and she foretells a more momentous future for Senussism than her facts warrant. But few sins of omission can be laid to her charge. As she has been at pains to collect all her facts and set them out honestly, her book will probably remain in current use by geographers longer than most records of travel, written quickly for immediate consumption. For Kufara, once visited and described, is not likely soon to draw another European across its forbidding ring of deserts. D. G. H.

A Vanished Dynasty: Ashanti.— Sir Francis Fuller. London: John Murray. 1921. Pp. xi. and 241. *Illustrations and Map.* 16*s. net.*

Sir Francis Fuller would have done meritorious work if he had simply disentangled the history of Ashanti, and in particular the record of its kings, from the mass of material dealing with the Gold Coast and other parts of West Africa. But he has done more. Profiting by his position as Chief Commissioner of Ashanti, and inspired by genuine admiration for the people over whom he has exercised authority, he has sought and found new material and woven old and new into one narrative. Modestly, he does not distinguish between what was known and what is new, but the student of Ashanti history and tradition should be grateful for the light thrown on obscure points. To the general reader the book is confidently commended as telling the story of an African race and dynasty which evolved a system of government possessing several good points, and warrior kings who also had claims to statesmanship. Perempe (Prempeh), the last of their line, is now an exile in the Seychelles, and the Ashanti, contented under British rule, are devoting themselves to the arts of peace.

The closing chapter deals with this change in the Ashanti outlook under British administration, and is full of interest and suggestive of big possibilities. Sir Francis Fuller has here a subject worthy of treatment at length, and no one has better qualification than he for giving us an account of the Ashanti of to-day. "Valiant, clever, and lovable," the Ashanti, alive to the benefit of education, opposed to Islam, but not unreceptive to Christian teaching, are one of the big assets of the British Colonial Empire. F. R. C.

The Life and Explorations of Frederick Stanley Arnot.— Ernest Baker. London: Seeley, Service & Co. 1921. *Illustrations and Sketch-map.* Pp. 334. 12*s.* 6*d. net.*

If Frederick Stanley Arnot was not a great explorer he did much valuable pioneer work in South Central Africa. As a missionary traveller he takes high rank. Born in Glasgow in 1856, young Arnot at the age of six met Livingstone, then home from his Zambezi expedition, and became a playmate of his children. The lad was enthralled by the story of Africa, and was fired with the ambition to go out and help Livingstone. Arnot did not reach Africa till 1881, when his hero's life had ended, but he was his true disciple in respect of the regions in which he travelled and (largely) in the methods he adopted in mission work.

Arnot's journeyings in southern Angola, Barotseland, Garenganze (Katanga), and adjacent regions of what is now Northern Rhodesia, continued from 1881 to his death in 1914 with scarcely a break. His early work on 'Garenganze' is a classic in missionary literature and a valued geographical record; the whole of his journeyings were summarized by himself in a book, 'Missionary Travels in Central Africa,' printed but a fortnight before his death and reviewed in the *Journal* in February 1915.

Mr. Ernest Baker, in this "authorized biography," now gives us Arnot's "Life and Explorations," letting Arnot, by means of extracts from his diaries, to a large extent tell his own story. These diaries show us Central Africa at a transition period, when witchcraft still held almost supreme sway over the natives, and the Arab slaver still flourished. They also unconsciously reveal the greatness of the man who wrote them. Arnot was looked upon as a saint, but he was a saint of shrewd common sense, humour, and kindliness, with a love of nature as well as of man. We are thankful to Mr. Baker for the skilful use he has made of these diaries, and should have been glad of a fuller account of Arnot's early life and upbringing; also of more colour in the narrative generally and a definite setting forth of Arnot's contributions to geography.

F. R. C.

AMERICA

A Labrador Doctor: The Autobiography of Wilfred Thomason Grenfell, M.D.(Oxon.), C.M.G.— London: Hodder & Stoughton. 1921. *Illustrations.* 15*s. net.*

This "wonderful autobiography of Labrador's famous missionary doctor" (to quote from the cover) is a remarkable account of adventurous travels and of solid achievements. As an autobiography it is a truly human document. Thirty-two years spent in work for deep-sea fishermen, of which twenty-seven were passed in Labrador and northern Newfoundland, have given the writer experiences of a unique kind. Dr. Grenfell has never been a man to run in a rut. Early in his career we find him ever on the look-out for a wider circle of friends and new enterprises to make more efficient the work of assisting those to whom he has given his life. The joys and sorrows, successes and failures he has met with are all entrancingly told here, and will arouse a sympathetic response wherever this book is read. Many adventures here compressed into a few paragraphs could easily have been spun out into long chapters. While the writer constantly lays before us the more attractive attributes of the fisher-folk and traders, he has scant mercy for those he found morally injuring "his people." The accounts of "The Co-operative Movement," "The Mill and the Fox Farm," "The Children's Home," and the "Reindeer Experiment"—all records of enormous difficulties overcome and in the end success sadly tempered by harassing set-backs—will deepen the admiration for his cheery optimism and his indomitable faith. Life has brought him countless friends, and to them this "wonderful autobiography" will prove the best material in their hands for ensuring "the future of the Mission."

E. W. G. M.

AUSTRALASIA AND PACIFIC ISLANDS

Wheat Production in New Zealand.— **D. B. Copland.** Pp. xx. + 312. Christchurch, N.Z.: Whitcombe & Tombs. 9*s. net.*

New Zealand is not generally regarded as a wheat-growing country of great importance. The average annual production is round about 7,000,000 bushels, which allows a small surplus for export beyond the home consumption. In the seventies of last century there was a boom in wheat-growing in New

Zealand, but since then the decline has been more or less steady. The fall in prices, the production in Canada, the Argentine, and Australia, and the growth of pastoral pursuits, with the development of the trade in frozen mutton and dairy produce, were all contributory factors in the decline. Mr. Copland goes at length into the geography and economics of wheat cultivation, and shows how production in New Zealand might be increased. In Canterbury and Otago alone, the two most suitable areas, he believes that 750,000 acres could be devoted to wheat. This would bring the annual production of New Zealand to over 18,000,000 bushels. The most serious obstacle Mr. Copland foresees is the lack of labour arising chiefly from the greater attractiveness of urban than rural life. The volume is a valuable piece of work, and it is worth noting that it is the outcome of investigations by students in Canterbury University College.

R. B.

POLAR REGIONS

Grønland langs Polhavet. Udforskningen af Grønland fra Melvillebugten til Kap Morris Jesup. Skildring af den II Thule-Ekspedition, 1916–18. Knud Rasmussen. Gyldendalske Boghandel, Kjøbenhavn og Kristiania, 1919. 4to. *Maps and Illustrations.*

It is well known that on the first Thule expedition in 1912 Rasmussen crossed the inland ice to Independence Bay and, independently of Mylius Erichsen, discovered that Peary Land is not an island. On the expedition of 1917, here described, he skirted the whole coast of northern Greenland from Thule on Wolstenholme sound to De Long fiord. The chief results of this expedition have already been reported in vol. **53**, p. 59. It may be added that Sherard Osborn fiord is only a third as long as hitherto supposed, and that Victoria Inlet is hardly more than 50 miles deep. It contains no island other than Stephenson island at the mouth. The long fiord running eastwards from near the mouth of Nordenskiöld fiord was named after J. P. Koch, and the western and eastern inlets of De Long fiord after Th. Thomsen and Prof. Böggild respectively.

From St. George's fiord the return journey was made overland, and the great scarcity of animal life, and therefore of food, threatened death to everyone, and Dr. Thorild Wulff, who had been ailing for some time, was unable to bear up against the difficulties of the route and starvation.

Reports are added on the botany and fauna of the country traversed and on the geology. The former is drawn up by C. H. Ostenfeld from Dr. Wulff's notes, and the chief features have been mentioned in the note referred to above. The poverty of the vegetation naturally entails a corresponding scarcity of animal life, and hence the party endured great hardships from want of food. Few musk oxen were seen, the first beyond Cape May, and ptarmigan were often hard to obtain, though this bird is generally distributed along the whole coast. L. Koch considers the folded range along the north coast of Greenland, the remains of which he discovered, to be a continuation of the Caledonian fold which runs from Scotland through Norway and Spitzbergen and is connected by a submarine ridge with north Greenland. Farther west it penetrates hrough Grinnell Land into Ellesmere Land.

The volume is well provided with sketch-maps and numerous photographs and coloured illustrations. The addition of rather long accounts of the travels of other Arctic explorers, and of Eskimo tales and other matter not strictly connected with the expedition, together with thick paper, has expanded it to an unwieldy size.

W. A. T.

Ergebnisse der Schweizerischen Grönlandexpedition, 1912–1913. Bearbeitet und redigiert von **Prof. Dr. Alfred de Quervain**, Leiter der Expedition, und

von **Prof. Dr. P. L. Mercanton,** Leiter der Westgruppe, und mit Beiträgen der Mitglieder: Dr. med. H. Hoessly, Dr. W. Jost, Dr. A. Stolberg, Ing. K. Gaule, Arch. R. Fick. Band 53, Denkschriften der Schweizerischen Naturforschenden Gesellschaft. Kommissionsverlag von Georg & Co. in Basel, etc. 1920. 4to. *Maps and Illustrations.*

Dr. de Quervain's expedition was noticed at the time in the pages of the *Journal*, and his narrative 'Quer durchs Grönlandeis' was reviewed in vol. 43, p. 689. In this volume are given in detail the scientific records of the expedition. The observations were very varied and numerous, as taken both before and during the crossing of the inland ice by the main expedition, and by a party left behind on the west coast, particular attention being given to glacial conditions and to meteorological elements by which they are affected. A few short notes on Dr. de Quervain's résumé of the topography of the inland ice may be interesting.

The first important geographical fact ascertained was that, as on Nansen's route, central nunataks do not occur, but that the surface of the ice in both cases assumes the same regular geometrical form almost independent of the underlying foundation, rising at first steeply from the edge and then more gently. About 60 miles north of the route followed and about the same from the western coast nunataks of considerable height do occur—the mountains of Schweizerland. While the highest point of the route, 2510 metres, is about 200 metres less than Nansen recorded, and Peary's maximum was 2400 metres, it was proved that the inland ice rises to the north-east, so that there is no continuous fall northwards. It has been shown by Dr. de Quervain's observations that there are two centres of glaciation, one between his crossing and Nansen's, and another to the north-east of his route, and probably there is a third north of Koch and Wegener's route. In the latitude of the Swiss expedition the dip of the ice is at right angles to the continental axis, that is, this axis coincides with the ice-parting. The foregoing statements need some modification from the fact that the lofty summits near the east coast seem to cause a marked displacement of the ice-parting eastwards, and form the backbone of glaciation in this latitude. Rising beyond the snow limit, they belong to the accumulation region of the inland ice and hinder the free flow of the ice eastwards. That the greatest elevation of the ice is west of these mountains and overtops most of them does not necessarily indicate a corresponding rise in the rocky substratum, for the centre of the Finno-Scandinavian glaciation, when at its maximum, lay not over the mountains, but over the Gulf of Bothnia. Other effects of the substratum are the terraced form of the inland ice, the crevasses noticed for a considerable distance inland from the west coast, and the influence of the great fiord system extending for at least 60 miles inland.

The inland ice is now a stationary glacier in which accumulation and ablation nearly balance each other, a relic of the diluvial ice wave which swept over America from west to east. It cannot rise to a greater elevation without causing atmospheric circulation of a more anticyclonal character, which would check its growth by reducing the precipitation. W. A. T.

MATHEMATICAL AND PHYSICAL GEOGRAPHY

Dictionary of British Scientific Instruments, issued by the British Optical Instrument Manufacturers' Association. London. 1921. 8vo. Pp. xii. + 334. *Price* 21*s.*

This work has the multiple object of providing a concise definition of each instrument, with illustrations of important types; of indicating the firms

(members of the Association) who either "manufacture or factor" such instruments; and of inviting the confidence and support of all who are interested in promoting and maintaining "the supremacy of the British Optical Instruments."

We regret that this laudable object is but imperfectly attained in the work now issued. Examining at random the definitions of survey instruments we find many wrong: *e.g.* In the "'plain' theodolite the telescope moves through an arc of about 45° upwards or downwards from the horizontal plane"; "Anallatic telescope . . . fitted with an additional lens in the focal plane of the object-glass"; "Dumpy level . . . in which the telescope is fixed"; or "Y level . . . readily reversed so as to eliminate errors due to the instrument not being set truly level." Others are but indifferent definitions, when not actually wrong: *e.g.* "Artificial horizon—an instrument used to give the true horizontal level . . ."; "Tacheometer: a transit theodolite having a distance-reading device in the telescope"; "Heliostat: an instrument consisting of an adjustable mirror or reflector worked in connection with a combination of telescopes, used in trigonometrical surveys: with it, triangles with sides over 100 miles in length can be measured"; or "Chronograph—a time indicator. Astronomical intervals are noted by pressing a key, which makes one dot or puncture on a travelling strip of paper at the commencement and another at the end of the observation." Included in the Dictionary are the Nocturnal (wrongly described), the Back Staff, the Octant, the Mural Circle, the Astrometeoroscope (which has nothing to do with astronomy), and the Astrodicticum, "by means of which many persons are able to view the same star at the same time"; but there is no mention of the Prismatic Astrolabe, nor of the Zeiss-pattern Level, nor of a geodetic pendulum later than Kater's, nor of the Zenith Telescope, nor even of the Micrometer Theodolite (except in an illustration). The picture of the ordinary "transit" theodolite shows the level on the telescope instead of on the vernier frame. The pantograph shown is not suspended; the map measurer has no counter; no base apparatus is described or illustrated; there is no mention of the Indian pattern clinometer. To compensate for these deficiencies there are prefixed to the Dictionary an article on Navigating Instruments dealing with the fore-staff and back-staff, etc.; an advertisement of the Royal Meteorological Society; an account of British optical glass of some interest; and a long historical description of the Royal Observatory at Greenwich.

Geographers are profoundly interested in the future of British instrument-making. It will appear to them deplorable that an Association including some of the principal firms in this country, claiming "to give its supporters a service in brains and goods that has never before been available," should at this critical time produce a book with so low a standard of education and of accuracy.

A. R. H.

GENERAL

The Diary of a Yeomanry M.O.— **Captain O. Teichman, D.S.O., M.S.** London: T. Fisher Unwin, Ltd. 1921. *Illustrations and Sketch-maps.* 12*s.* 6*d. net.*

This medical officer, who had the good fortune to serve on a variety of fronts —Egypt, Gallipoli, Palestine, and Italy—here gives us his recorded observations written day by day. Though written by an M.O. the writer shows himself to have been fully alive to all the events which were occurring around him. Some authors might have woven this material into a great book, but perhaps these jottings, written "often under considerable difficulties and on odd scraps of paper," will be of all the greater interest to those who took part in the events

and the more convincing to those who have followed them only in official or semi-official accounts. The "Sinai Desert" and the "Palestine" campaigns fill most of the book, but the short chapter on some of the fighting on the Piave records perhaps the least known incident in the story. "The great tragedy of the first battle of Gaza" is described as a "ghastly fiasco"—it could seem little else to one who took part in it—and the second battle was an even more complete failure. The first advance across the Jordan in summer fully described here is also dubbed a "fiasco," but such a verdict requires revision in view of the way this temporary failure—a failure due largely to the Arabs' want of faith—eventually became a link in the chain of events leading up to General Allenby's final triumph.

Not every one will sympathize with the account given of British officers rifling tombs at Abu Shusheh (here miscalled Abu Shushar). During these irregular proceedings "a little French Jew made his appearance during the afternoon and asked if he also had permission to excavate. Naturally this was refused, and he appeared the next day with a long rigmarole about his being the agent of some colonization society to whom the land belonged. Eventually he became so troublesome that we had to throw him down the hill."

It may be remarked that the "French Jew" was probably quite right, as this land does belong to a Jewish Colonization Society, having been especially acquired because of its archæological treasures. It was one of the first acts of the British authorities to issue orders against all unauthorized digging even by those to whom the land belonged. The diary continues, "A few days later our C.O. received an order from H.Q.L. of C. to stop any of his officers who might be carrying on excavations at Abu Shushar; however, we were able to find another locality, and continued our work for some weeks"!

The writer can have little conception how damaging to real archæological progress this kind of irregular work is; the results are practically valueless to those who do it, and are still worse in their effects upon the natives who have already done irreparable damage by this kind of thing, and can never be made law-abiding with such bad examples as this on the part of British officers.

E. W. G. M.

Terry's Short Cut to Spanish.— **T. Philip Terry.** Pp. 543. 17 × 12 cm. Boston and New York: Houghton Mifflin Co. 1920. $2.50.

This extremely useful book is no mere grammar of classical Castilian, of which there are many. It is a veritable *vade mecum* on all that the traveller, the merchant, or the English resident in any of the twenty-one countries where Spanish is the national tongue, finds needful for the acquirement of a practical, and especially colloquial, fluency in the language. It supplies, besides the orthodox material of a grammar, just those many bits of information and points of distinction for which the intelligent learner sighs, but which he fails to find elsewhere in print. It is particularly rich in "Americanismos" and in explanations of the differences heard in daily conversation between the Spaniard of Old Spain and his cousin of the New World. Part iii. of the volume is virtually, as the author observes, a separate book, which he modestly calls a "Pocket Interpreter for English-speaking travellers in Spanish-speaking countries." But it is much more than an interpreter, teeming as it does with useful—one had almost said indispensable—information on a hundred and twenty-six subjects not readily met with elsewhere in so compact yet comprehensive a form; and it may confidently be predicted that this will in future become the book of all others for the intending traveller in Spanish America to provide himself with, and study.

B. G. C.

The Statesman's Year-book.— Edited by **Sir John Scott Keltie** and **M. Epstein.** London: Macmillan. 1921. Pp. 1544. *Price* 20*s. net.*

The path of the editors of a work like the Statesman's Year-book must still, under existing conditions, be beset with well-nigh insuperable difficulties. In the present issue, as in that of 1920, they have been attacked with courage and success, and further progress has been made towards the presentation of a final view of the world's politics as they gradually settle down after the great upheaval. Of the new political entities which have emerged from the chaos of the war, four more—Esthonia, Georgia, and Latvia, with the minute territory of Fiume—now take their place as independent units, in addition to Finland, Poland, Czecho-Slovakia, and Yugo-Slavia, which had made their appearance previously. The last-named still appears under the cumbrous official designation of the "Serb, Croat, and Slovene State," though the more convenient popular name has been accepted for general use by the P.C.G.N., whilst the conventional but incorrect name Czechoslovakia is adopted in the Year-book, possibly from a desire to retain the state in the place formerly occupied by Serbia, its most important constituent. As an instance of the up-to-date character of the statistics even for these new States, it may be noted that there is a table under Poland showing the weight of crops, for each of the districts of which the State is composed, in 1919 and 1920, the latter year showing a satisfactory advance in each item but rye. For the older countries it is hardly necessary to state that the statistics have been revised with the usual care, recent census returns having been embodied in the case of nine states.

As usual, the introductory tables are of great interest, as supplying an indication of the trend of various economic factors such as the production of gold, sugar, cotton, etc., etc. The steady decline in the world's output of gold during the years 1916–20 is well brought out. A slight fall in sugar production in 1919–20 has been replaced by a distinct rise in 1920–21, the largest producer being Cuba, which is responsible for almost one-third of the whole cane-sugar crop, and nearly a quarter of the total of beet and cane-sugar combined. Of special interest is the table headed, as usual, "World's Shipbuilding," but which really gives the figures of *ownership* by the principal countries. Many will no doubt be surprised to learn (though the fact has been commented on in the public press) that, owing to the great building activity in the United States, the World's tonnage has *increased* since 1914 by 8½ million tons. The United Kingdom has almost regained the ground lost during the war, partly, no doubt, as a result of the transfer of German shipping, which has apparently also been responsible for the large increase in that now owned by France. The table showing the comparative strength of the navies of the world illustrates the speed with which figures need revision, the drastic reduction of the British fleet which finds expression in the body of the work being still more marked in the introductory table, particularly in the matter of light cruisers. The most useful list of treaties by which recent changes have been brought about is extended, as compared with 1920, from twenty-one to thirty-four items. Lastly, the maps showing the States of the Baltic region, and the area of North Slesvig added to Denmark, in conjunction with those given in the last two issues, complete the picture of territorial change, so far as it has yet become definitive.

The Tin Resources of the British Empire.— **N. M. Penzer.** Pp. x. + 358. London: W. Rider & Son. 1921. *Maps and Illustrations.* 15*s. net.*

The series to which this volume belongs was planned to deal with the distribution of the raw materials of industry throughout the world. The British

Empire produces two-thirds of the world's tin output. The only foreign countries of importance as tin producers are Bolivia, China, the Dutch East Indies, and Siam. It is a pity that these could not have been included, but we understand that considerations of bulk and space induced the publishers to defer treatment of foreign countries to a later volume, which we hope will be published before long. Mr. Penzer has done his work of compilation well, and produced a most useful book of reference—ample details of the occurrence, nature and working of all deposits, together with notes on the estates of the principal companies. There is a full bibliography arranged chronologically by continents. As a rule it begins with works published in 1910, but in some cases goes back to an earlier date. The sketch-maps are useful. R. B.

The Gateways of Commerce.— **J. Fairgrieve and E. Young.** London: G. Philip & Sons. 1921. Pp. viii. + 272. *Sketch-maps.* 3*s.* 6*d. net.*

This is the first volume in the New Era Library, which studies to give a wide general view of various important topics, unburdened with excessive detail. The present volume fulfils these requirements, being clearly written and assuming little if any previous knowledge on the part of the reader. The authors have been largely successful in their aim "to build up a picture of the world on its economic side," although they appear to regard economic geography as practically synonymous with the geography of commerce. Their outlook, however, is not narrow in their treatment of the subject, and they indicate the wide influences that affect the distribution of industries and the flow of trade. One or two statements are open to criticism. The argument relating the tea plant to a warm wet climate (p. 14) needs overhauling, and some revision might be suggested of the statement on p. 19 that the excess of labour has led the monsoon peoples to develop industries, such as the cultivation of rice, tea, and silk, in which that excess can most profitably be employed. The book is illustrated by over sixty sketch-maps, but we miss an index. The publishers deserve congratulation on the use of a clear bold type, which greatly facilitates reading. A cheaper edition in limp cloth is published at half a crown. R. B.

Commercial Commodities.— **F. W. Matthews.** Pp. 320. London: Sir I. Pitman & Sons. 1921. 12*s.* 6*d. net.*

The author has compiled a useful catalogue of commercial products with copious notes on their distribution and preparation. The book is really a condensed encyclopædia, arranged not alphabetically but genetically. It does not aim to be exhaustive, but is certainly most informative and commendably accurate. A very short introduction explains the various methods of preserving organic substances in commerce. As a book of reference it should prove useful to teachers and others. R. B.

THE MONTHLY RECORD

EUROPE

The Dune-belt of Belgium.

LIKE the neighbouring parts of Holland and France, the coast of Belgium is fringed throughout its length by a belt of dunes, widening in places to a breadth of 1500 or 2000 metres, and in others narrowing to one of only 12 to 15 metres, the mean height being about 20 metres. A study of this tract from the point of view both of the physical formation and of the life of its inhabitants is

given in the *Bulletin* of the Royal Belgian Geographical Society for 1920, Part 2, by Phina Lecouturier, well illustrated by photographs, maps, and diagrams. In general the belt is formed of two parallel lines of dunes, the outer moving, the inner stationary, both parallel to the coast and oblique to the direction of the prevailing wind. The outer line forms a regular wall broken only by narrow breaches, and the inner line seems also to take a more or less regular course, while the central dunes are very varied in form and are ranged broadly in lines oblique to the coastline. Among the latter occur depressions, sometimes dry, sometimes wet, known locally as *pannes* and corresponding to the *lettes* of Gascony. The individual dunes owe their origin generally to the shelter from the wind afforded by an obstacle such as a tuft of vegetation. The fixation of the inner line is of course due to the lessened force of the wind at a distance from the sea and the greater chance given for the growth of vegetation. This consists chiefly of four species—the "Oyat" (a grass), *Carex arenaria*, *Salix repens*, and the "Argousier" (a spiny shrub 2 to 3 metres in height), the botanical name of which is not mentioned. Of these the first-named is widely planted for the purpose of fixing the dunes. It is especially adapted to stand the fluctuations of level by either elongating its stem or sending out new growths from the lower portion. The *Carex* adapts itself to changes of level by sending out fresh rhizomes beneath the surface. Attempts at tree-planting have met with little or no success.

At first sight this tract would seem to be of an unpromising nature ; yet it is well peopled, chiefly by reason of the presence everywhere of a good water-supply at a slight depth, the elevation of the ground relatively to the maritime plain, the vicinity of the sea and the livelihood thus afforded by fishing, the use of the tract as a line of communication, and so on. The population consists of fishermen, market gardeners, agricultural labourers, and artisans, principally the two first ; all are occupied more or less with cultivation. Life in the open makes them sturdy and vigorous, rough in manners but sober and content with little. The lack of fertility limits cultivation as a rule to rye, potatoes, and vegetables grown for consumption in the neighbouring watering-places. The cultivators rarely employ outside labour, each family doing its own work. Domestic animals are few, chiefly mules and donkeys for transport purposes, a few lean cows, sheep or goats, but more pigs. The dwellings are the usual one-storied buildings of the Flanders littoral,* sometimes consisting of a single room only, and rarely possessing more than three. They are grouped in twos or threes in such a way as to best enjoy protection from the prevailing winds. The watering-places are of two classes, the older, in which all trace of the original dune surface has been lost, marked especially by the importance of the sea-wall running along the front; and the newer, formed in the vicinity of the old dune villages, in which the sea-wall is less in evidence, and in which there has been some attempt at picturesque effect by retaining the natural surroundings. There is something imposing in the aspect of the dune belt as seen from an elevated point, and the life of man, plants, and animals within it possesses a special interest as an example of persevering struggle against adverse conditions.

The Vatnajökull, Iceland.

Our knowledge of this vast accumulation of ice—the greatest area of the kind in Iceland—has been considerably increased by the expedition of the Swedish student, Mr. Hakon Wadell, to which brief reference was made in the *Journal*, vol. 54, p. 323. An account of his journey, with a summary of

* Cf. note on rural dwellings in France, *Journal*, vol. 57, p. 308.

previous work and full description of the features and physical conditions of the Jökull, is given by Mr. Wadell in the *Geografiska Annalen* (Stockholm), 1920, pt. 4, well illustrated from photographs and accompanied by an excellent map. Of early investigators, special mention is made of the Icelanders Thordur Vidalin (1662–1742) and Sveinn Pálsson, the latter of whom wrote a treatise in 1734, which remained till quite lately the fullest work available on the glaciers of Iceland. He was much before his time in many ways, holding *e.g.* that glaciers were plastic and could adapt themselves to the ground. Our knowledge of the Vatnajökull has remained very imperfect down to the present, concerned chiefly with the southern marginal glaciers. Its vast central expanse had been crossed three times only—by the Englishman Watts in 1875 from south to north, by Wigner and Muir in 1904 from north-east to south-west, and by the Dane J. P. Koch in 1912. Mr. Wadell undertook his expedition in 1919, in company with Mr. E. Ygberg, with a view to investigating this central region and above all to a search for the cause of the *jökullaup*, or "glacier-run,"; observed particularly in the Skeidararjökull, one of the southern marginal glaciers; when it occurs in a serious form, whole parishes may be swept away by the torrent of water. Starting on August 27 from Kalfafell, south of the Skaptárjökull (the great south-western lobe of Vatnajökull), the travellers went first north and north-east to a point near the central line of the icefield, difficulties being caused by the layer of volcanic ash due to the eruption of Katla; they then turned east across a level plateau 1500–1600 metres above sea-level. On August 31 they reached the crown of the ice dome (1700 metres) and soon afterwards a huge crater-basin, which investigation indicated as the source of the *jökullaup*. Fog and heavy snowfall made it necessary to hurry on to the south-east, and before reaching the margin of the ice on September 5 it had been necessary to leave the heavy equipment to be fetched later. In endeavouring to do this the party was again overtaken by a snowstorm, and much of the equipment and collections was unfortunately lost.

Including its marginal glaciers, Vatnajökull has an area of about 9000 square kilometres. In its eastern half it may be styled a plateau glacier, the surface being generally level and uniform, with an elevation of 1600 metres. In the west it is more broken, the northern part being traversed by an ice-clad mountain ridge 1900 metres high; while further south several sharp peaks shoot up above the surface, and a mountain ridge, the Jökullklettur, runs up from the sandy plain to the south, separating the Skaptarjökull from the Sidujökull to the east. The southern marginal glaciers have more or less the appearance of valley-glaciers, while in the north and west the ice flows in broad tongues over an evenly sloping bed. The boundary between the high-glacier and the marginal glaciers runs at about 1400 to 1500 metres, being marked by a steeper slope and the gradual cessation of crevasses. The volcanic nature of the region has long been known, and the *jökullaup* has been attributed to the effect of such action. The discovery of the Sviagigur crater has confirmed this idea. It is a deep bowl-shaped depression, about $7\frac{1}{2}$ by 5 kilometres, with a depth of 80 to 100 metres, and is occupied by a lake fed by the masses of ice pushed over the crater walls from all sides in quantities too great to allow all to be melted at once. The walls were difficult of access, but at one point were found to consist of alternate layers of basalt, hardened moraine, and tufa; they had very fresh surfaces. From observations of the column of ashes seen during the violent eruption and *jökullaup* of 1903, and other considerations, the site of the outbreak would seem to be almost certainly in this neighbourhood. The layer of volcanic ash which covered the ice at the time of the journey greatly facilitated the

observations of the glacial economy, by permitting a determination of the amount of accumulation and wasting during the year. These processes are fully discussed, it being found that within the area of waste in the south the annual melting at 900 metres amounts to 4 metres, decreasing upwards until at 1300 metres the accumulation and melting balance each other. The orographical snow-zone is one of transition, and is divided into two by the annual snow-line, below which melting is predominant, above, accumulation. Even in the névé region some melting takes place, the annual accumulation at 1600 metres varying from 1·5 to 3 metres. The total thickness of the ice in the central parts varies between 8 and 15 metres.

ASIA

Hokkaido and its Resources.

A convenient summary of the geographical character and economic position in Hokkaido, the "northland" of Japan, is given in the *Geographical Review* for January 1921, in part from personal knowledge, by Mr. W. D. Jones of the University of Chicago. Points both of similarity to and contrast with the more southern Japanese islands are noted. The structure and topography are generally similar, Hokkaido having relatively much hill and mountain—not as a rule high or rugged—and little lowland plain. Most of the streams are swift, and navigable only by small boats and rafts. Contrasts on the other hand are numerous, climate standing in the forefront. While most of the main island has a climate comparable to that of the Carolinas, that of Hokkaido is much like that of Wisconsin or New England. Rice occupies the largest acreage in the southern islands, peas and beans in Hokkaido, with potatoes next in importance. Other cereals—oats, barley, maize, buckwheat, and millet—are grown in both, but mainly as winter crops (except maize) in the south, as summer crops in the northern island. Of late years, however, it has been found that rice will thrive in the interior lowlands, particularly the Ishikari plain, and its cultivation has developed rapidly, but it is improbable that it will become the dominant crop. Agriculture has hitherto been of less relative importance and less intensive in Hokkaido than in the rest of Japan, though this difference may not be permanent. Stock-raising is of more importance, the climate favouring the growth of forage plants, though the number of cattle is still small by comparison with, say, Wisconsin, where the proportion per head of population is over 113 times as great. The important fisheries of Hokkaido—principally herring, cod, and salmon—were long the chief industry, and, as the summer settlements on the coast formed for this purpose gradually gave place to permanent villages, tended to promote agriculture also. These villages with their solidly built log houses with roofs of shingles, and sharp-prowed fishing boats, add a picturesque element to the landscape.

Since about 1890 the forest resources—chiefly oak and pine—have been rapidly developed, but with the wasteful methods employed must decline before long. The logs are as a rule floated down the rivers to sawmills near their mouths—those at Tomakomai on the southern coast being perhaps the largest of their kind in the Far East. The forests show a marked contrast with those of the southern islands, the red pine and broad-leaved evergreens of the latter giving place to northern conifers and mixed hard wood and conifers. The relative nearness to the Siberian mainland may in part be responsible for this. Coal is an important resource, the chief fields being in the Yubari district. Of the ports, Hakodate has of late years been passed by Otaru, its advantage as nearest to Honshiu and possessing a far better harbour being offset by the nearness of Otaru to the main productive area—the Ishikari plain—which

causes it to handle the bulk of the commerce. Muroran, on Volcano bay, has an excellent harbour and is the chief export port for Yubari coal. Sapporo, the capital, lies inland on the Ishikari plain. Although "artificially" established by the government, its favourable geographical position is chiefly responsible for its rapid growth. In its substantially built houses—rendered necessary by the climate, but due in part to American influence—it presents a marked contrast to the cities of old Japan. In spite of many advantages Hokkaido has not attracted immigrants to the extent that might have been expected, the somewhat hard conditions of life having proved repellent to the home-loving Japanese, but there has been a decided increase of late. For many years, however, the population will be too small to require anything like all the products of the island for home consumption, so that it will be an increasingly important source of food-stuffs and the raw materials of industry for Southern Japan.

AFRICA

Desiccation in French West Africa.

The often repeated question whether a progressive desiccation can be traced in the zone of deserts and semi-deserts, or even in the Earth as a whole, is considered by Dr. H. Hubert, in its bearing on French West Africa, in a paper reprinted from the *Bulletin du Comité d'Études . . . de l'Afrique Occidentale Française* for 1920. The question was one proposed for study by the Comité d'Études in view of the practical importance of the subject to the development of the country, and in the paper in question Dr. Hubert has not only brought together a useful body of evidence collected on the spot, but has summarized effectively the general conclusions to be drawn. These, it must be confessed, are not quite so positive as might be wished, depending mainly on the balance of probabilities, in assessing which Dr. Hubert's bias towards a belief in such progressive desiccation can hardly have failed to somewhat influence his judgment. Still, it can hardly be denied that a considerable body of facts tending towards such a belief has been brought together. The writer discusses the subject under the heads of four successive periods—the geologic, *i.e.* the period, since the beginning of the quaternary, for which human documents do not certainly exist ; the pre-historic, for which the existence of man has been established, but for which there are no written documents ; the historic, for which there are either written documents or oral traditions to go upon ; and the present, dating from the French occupation only. During the first period he holds it as proved that the whole country, even the desert of to-day, possessed a river system which, from its much more copious character, argues a distinctly moister climate. In the pre-historic period, the early part of which may coincide with that already considered, the regions now desert and frequented only by nomads appear to have been inhabited by a sedentary black population, which may, it is true, have been pushed southward by Arab and Berber invasions, but which could certainly not thrive under the conditions now obtaining. For the historic period the evidence, Mr. Hubert allows, is more or less contradictory, but while agreeing that the earliest written documents point to conditions not very different from the present, he is inclined to attach more weight to oral traditions in favour of change, supported as they are by evidence of a southward retreat of certain animal species. During the past sixty years he likewise sees signs of progressive desiccation which seems to have become aggravated during the last twenty years or thereabouts ; the facts recorded being impossible of explanation by mere fluctuations in the rainfall. The process is vouched for, Dr. Hubert thinks, alike by the shrinkage of surface and underground waters, by the diminution

of vegetation, the advance of the sand, the greater ravages of termites, and the exodus of the population of certain districts. As to the causes of such desiccation the most important would seem to be a diminution of precipitation, which may more or less suddenly produce great effects by reaching a stage when all the rain which falls is absorbed or evaporated. Other causes suggested are the breaking down of bars which hold up the water, erosion (which may remove the superficial clays and permit the water to sink into the underlying limestone), the advance of the sands, and, possibly, though acting more slowly, the alteration of drainage by river-capture. To these natural causes may be added various artificial ones, notably the reckless destruction of shrubby vegetation. Remedial measures of various kinds are suggested as likely to check the process, and their immediate adoption is advocated.

AMERICA

The Mackenzie as a Source of Arctic Driftwood.

Mr. E. M. Kindle (*Geogr. Review*, January 1921) considers that the importance of the Mackenzie as a source of the driftwood found in such quantities on the Arctic coasts of Alaska and Canada has been somewhat overlooked. In assigning the places of origin of the forty samples collected by the *Fram* during the second Norwegian Arctic Expedition, Dr. Ingvarson placed first the Siberian rivers Yenesei and Lena, next the St. Lawrence, and third the coast of Norway, the Mackenzie being not even mentioned. There are no doubt causes tending to restrict the supply from the Mackenzie. Thus the vast quantity carried by the Slave River and its tributaries ends its northward journey in Great Slave Lake, whilst by reason of its comparatively straight course and frequent boulder-paving the main stream takes a relatively small toll from its own banks. Great Bear Lake again retains the supply that enters it, so that the Bear River—the only large eastern tributary—contributes only that derived from its own banks. This is of some importance during the spring break-up owing to the amount of the moving ice and the destructive action of ice-jams. But the main source of driftwood to the Mackenzie is the western tributaries—notably the Liard, the basin of which yields trees of considerable size. Mr. Kindle describes in vivid terms the spectacle viewed by him in 1919 near old Fort Good Hope. The unusually high stage of the Liard in that year set afloat a vast quantity of stranded logs, and the main mass of the driftwood began to reach the fort about July 13. The immense volume of the floating mass exceeded, he says, anything previously seen or imagined. Even where closely packed it spread over a width of a quarter of a mile or more, and occupied about four days in passing a given point, whilst detached masses followed for several days more. Travellers speak of the immense amount of driftwood seen on the mainland coast both east and west of the Mackenzie mouth, and there can be little doubt, Mr. Kindle thinks, that it is distributed far and wide through the Arctic Archipelago.

OBITUARY

Colonel H. W. Feilden, C.B.

WHEN Colonel Feilden died on June 18 last, in his eighty-third year, he had outlived most of his contemporaries, and few are left who were his comrades as a gallant soldier and an enthusiastic naturalist-explorer. A multitude of friends will continue to cherish the memory of the public-spirited country gentleman and helpful adviser, who by example and precept cheered and

stimulated his neighbours through the heavy years of the Great War, and never failed in appreciation of the efforts of explorers.

Henry Wemyss Feilden was born on 6 October 1838 at Newbridge, in Ireland, where his father, Sir W. H. Feilden, second baronet, was stationed as a cavalry officer. In 1856, at the age of eighteen, he joined the Black Watch at Stirling, and was at once sent abroad on active service. He fought as a subaltern in the suppression of the Indian Mutiny, and in 1860 was attached to the 8th Punjabis, and went through the China war with that regiment. On his return from the East he was not tired of warlike adventures, but turned at once to the West as a volunteer in the American Civil War, through which he served from 1862 to 1865 in the Adjutant-General's Department of the Confederate Army until, with the remnant of the army of the Tennessee, he surrendered to General Sherman. In 1864 he married an American lady, with whom he lived in devoted happiness until her death in 1920. After the American War Feilden returned to the British Army, and was a captain in the Royal Artillery in 1874; he saw active service again in the Boer Wars of 1881 and 1900–01, serving on the latter occasion in the Paymaster-General's Department, and receiving the Companionship of the Bath. Notwithstanding his advanced age, Colonel Feilden tried every means of returning to active service in 1914, but the War Office drew the line at colonels of seventy-six. Not to be daunted, he went to Lichfield, and succeeded in being taken on as a clerk in the pay-office there; but he was found out as over age, and had to expend his inexhaustible energy in promoting a proper spirit in his home village of Burwash, where he was prominent in cultivating his own garden as an example to his neighbours, and as a leader in all patriotic work.

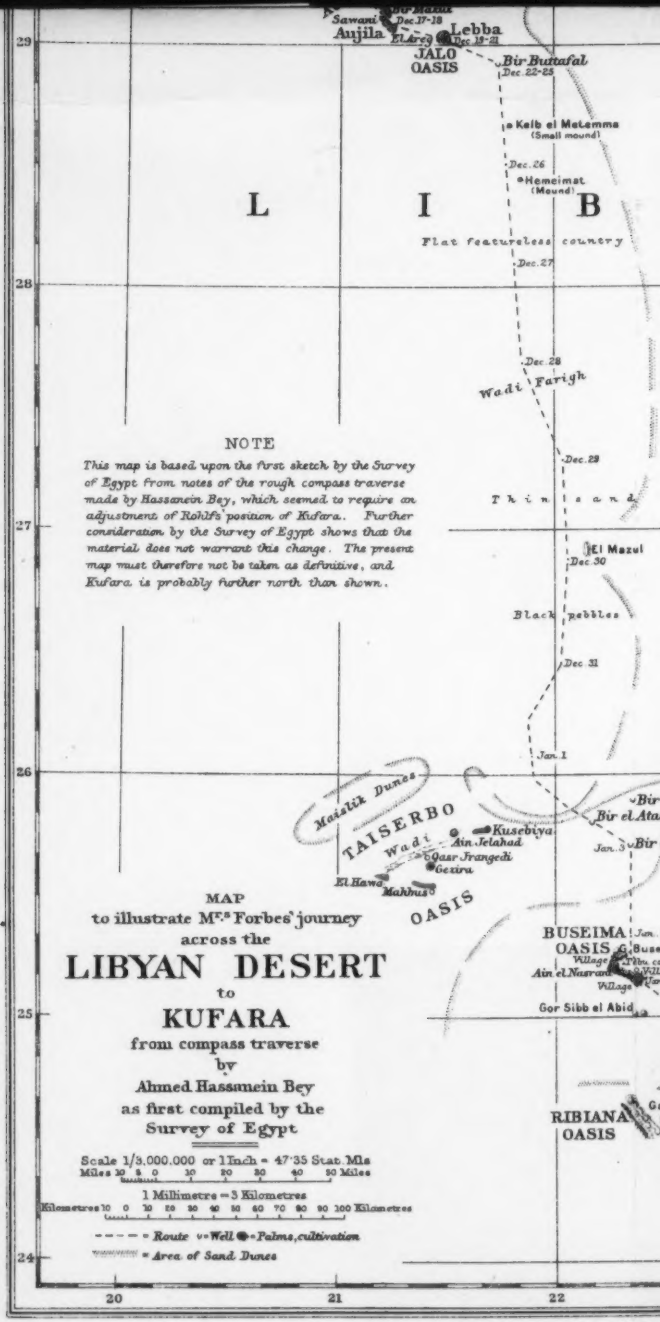
Colonel Feilden was as keen a sportman as he was a soldier, and but for his more serious claims to distinction he would have been noted for his feats with rod and gun in many parts of the world. Like many of the best type of sportsmen, he took a scientific interest in the wild life of the regions he travelled in, and, adding study to the observation which was instinctive with him as a born naturalist, he made himself an authority in several departments of botany, zoology, and geology. That his reputation was not enhanced by some of the more striking scientific distinctions was mainly the result of his own modesty.

Before 1875 the studies of Captain Feilden had given him such a standing in the scientific world that he was selected as naturalist to Sir George Nares's North Polar Expedition, and sailed in the *Alert*. In that ship he wintered further north than any previous expedition, and had the opportunity of forming an extensive collection of the fauna and flora of the polar zone as well as geological specimens. His descriptions of the collections appears in Sir George Nares's official account of the expedition, and special studies are also described in the *Annals and Magazine of Natural History*. In 1895, and again in 1897, Colonel Feilden accompanied Mr. H. J. Pearson on expeditions to Spitsbergen, Novaya Zemlya, and the entrance to the Kara Sea, the results of which he communicated to the Royal Geographical Society on his return.

Colonel Feilden was a familiar figure at the meetings of the Society, and was always ready to take part in the discussion of polar papers and in advising polar travellers. He made a comprehensive collection of polar literature, including some interesting MSS., and a few years before his death he presented the whole, extending to over 600 items, to the Royal Geographical Society for preservation in the Library. He also presented his unpublished private journal kept on the north polar voyage of the *Alert*, which is a document of considerable interest and value. He had been a Fellow of the Society since 1875 and served on the Council from 1908 to 1911. H. R. M.

20
21
BENGHAZI
El Abiar
32
Bu Driss
Ghemines
GULF
OF
SIDRA
Soluk
Tilimun
Sheleidima
Maus
CYRENAICA
Bevlaton
Bueb
Bay
31
Zuetina
Garet el Hadid
Jedabiya
Dec. 8 1920
Wadi Fariqh
Dec. 12
Dec. 13
30
Qasr el Sahabia
Bir Hassam
Bir el Mareg
El Arida
Dec. 14
Dec. 15
Hasiyet Buddafar
Garet el Melh
Dec. 16
AUJILA OASIS
Bir el Sabil
Bir Maxux
Sawani
Dec. 17-18
Aujila
El Arej
Lebba
Dec. 19-21
29
JALO
OASIS
Bir Buttafal
Dec. 22-25
20
30
25
Scale 1/13,000
Route

MEDITERRANEAN
SEA
CYRENAICA
Libyan Plateau
LIBYA
EGYPT
LIBYAN DESERT
ALEXANDRIA
CAIRO
Jaghabub
Siwa Oasis
Jalo Oasis
Augila Oasis
Bahariya Oasis
Farafra Oasis
Dakhla Oasis
Kharga Oasis
Dush Oasis
Tazerbo Oasis
Buseima Oasis
Ribiana Oasis
Kufara Oasis
Gabel
Hawaish
Tobruk
Derna
Tolmetta
Bardia
Solium
Matruh
Rosetta
Mersa
Zuetina
Jedabiya
Wadi Farigh
Bir Rassam
Qara
Moghara
Qattara
The Fayyum
Medinet el Fayyum
River Nile
Asyuta
Areg
Bawiti
Qasr Farafra
Bir Abu Mungar
Qasr Dakhl
Belat
Bir el Atash
Bir Zakar
Bir Buttafel
Bir Tarfawi
Bir Sahara
Bir Natrun
Bir Hacheim
Bir Kenayis
Bir Sidi Muftah
Bir Tengeder
Bir Sheferzen
Bir Murr
Bir Sciatt
Bir Gifgafa
Bir Tamai
Bir Sidi Rahman
Bir Hakim
Bir Misheifa
Bir Qattara
Bir Abu Dweis
Bir Kan



NOTE

This map is based upon the first sketch by the Survey of Egypt from notes of the rough compass traverse made by Hassanein Bey, which seemed to require an adjustment of Rohlfs's position of Kufara. Further consideration by the Survey of Egypt shows that the material does not warrant this change. The present map must therefore not be taken as definitive, and Kufara is probably further north than shown.

MAP
to illustrate Mr.s Forbes' journey
across the
LIBYAN DESERT
to
KUFARA
from compass traverse
by
Ahmed Hassanein Bey
as first compiled by the
Survey of Egypt

Scale 1/3,000,000 or 1 Inch = 47·35 Stat. Mls
Miles 30 5 0 10 20 30 40 50 Miles
1 Millimetre = 3 Kilometres
Kilometres 10 0 10 20 30 40 50 60 70 80 90 100 Kilometres
= Route v = Well ● = Palms, cultivation
= Area of Sand Dunes

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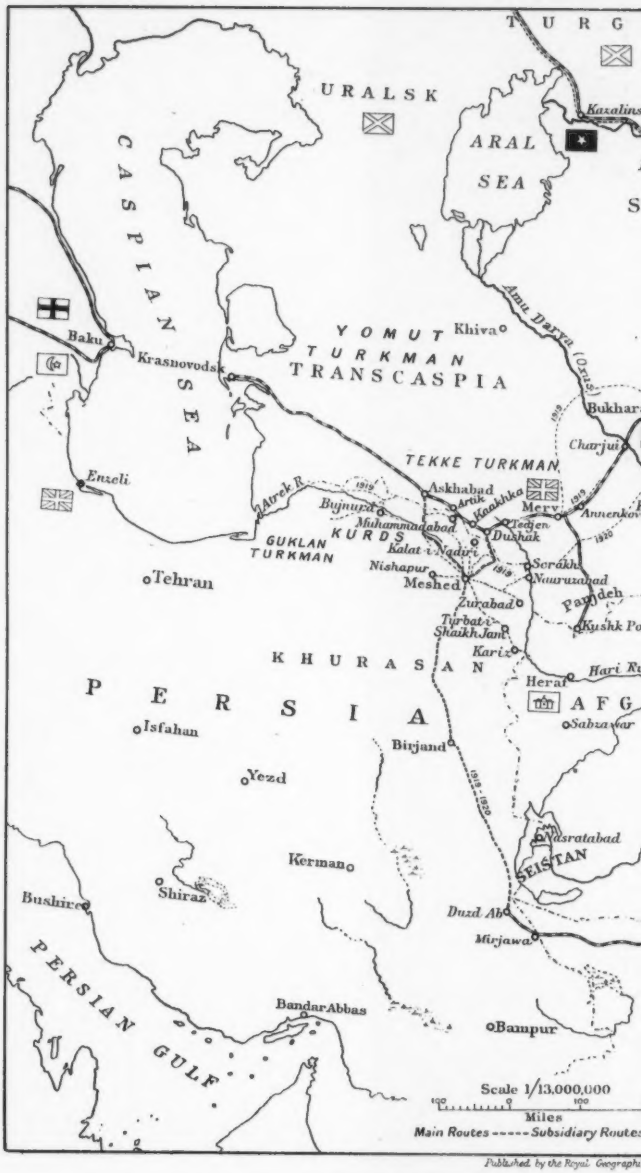
Geographical Society

LIBYAN DESERT
Forbes



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Sketch-map showing routes of Captai

of Captain Blacker's Detachment, 1918–20.